J. New York Entomol. Soc. 101(3):301–390, 1993

THE BLACK FLIES OF THE GENUS *SIMULIUM*, SUBGENUS *PSILOPELMIA* (DIPTERA: SIMULIIDAE), IN THE CONTIGUOUS UNITED STATES

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Abstract.—Keys, descriptions, and illustrations are provided to aid in the identification of the females, males, pupae and larvae, where each is known, of the eight species assigned to the subgenus *Psilopelmia*, of the genus *Simulium*, in the contiguous United States. Two species, *S.* (*P.*) *labellei*, and *S.* (*P.*) *robynae*, are described as new. Remarks concerning the taxonomy and biology of each species are provided, and the known distributions by state and county are given.

TABLE OF CONTENTS

This paper treats eight species of the subgenus *Psilopelmia* Enderlein, of the genus *Simulium* Latreille. It is the first of several works intended to treat the species of various subgenera of the genus *Simulium*. This study has some applicability to the fauna of Canada and Mexico, but emphasis has been placed on the species within the contiguous United States.

Table 1. Biting Records

HOSTS	Black Fly Species							
	bivittatum	grisseum	labellei	mediovittatum	notatum	robynae	trivittatum	venator
Man	X	X		X			X	X
Horse	X	X		X		X	X	X
Mule				X				
Donkey				X				
Cattle	X	X				X?	X	
Dog								X
Rabbit		X		X		X		
Hawk	X?							
Owl	X?							

This paper is a descriptive work with keys and figures to facilitate the identification of the species treated, some of which are pests of livestock and, to a lesser extent, other animals and man (Table 1). It deals with the morphospecies level of black fly identification, or the species as they are currently known. Hopefully, it will be of use to other systematists who may eventually utilize cytotaxonomic or other techniques to check for cryptic species, or attempt a phylogenetic analysis of the group.

MATERIALS AND METHODS

The males of each species are rather uniform in their color patterns, and these patterns, in combination with genital characters, usually allow accurate identification. On the other hand, the yellowish females are quite variable in their color patterns and intensity. This variability, whether naturally occurring or due to recency of emergence or other factors, is especially evident between dry, pinned specimens and those preserved in fluid. With experience, most specimens can be reliably identified to species despite such color variations. However, there are both male and female specimens that somehow defy identification, and no claim is made that the keys will allow perfect identification of all specimens. The pupae and larvae are much more difficult to separate but the keys should be helpful in most cases. Freshly preserved, mature larvae (those with darkened respiratory histoblasts) and pupae are easier to identify than immature specimens or those that have been preserved for a long time in fluid. Both the keys and descriptions were prepared using recently collected, or other available, reared adults and their associated pupal pelts and mature larvae.

Because most black fly genera contain cryptic species complexes, some, or perhaps all of the species recognized here by morphological features may eventually prove to consist of such complexes. As part of this study I wanted to determine, if possible,

whether the various thoracic color patterns were due, at least in part, to some microstructure of the integument of the dorsum of the thorax, or if these patterns were due to pigment or other factors. As can be seen by the appropriate micrographs (Figs. 130–132, 135, 141, 143, 150–151), color patterns probably are due, at least in part, to the microstructure (microtomentum) of the thorax. Hannay and Bond (1971b) working with *Simulium vittatum* Zetterstedt, and Lowry and Shelley (1990) using three Neotropical species of *Simulium,* demonstrated structures, similar to those shown here, that they indicate are responsible for various thoracic color patterns. This approach may prove useful in separating cryptic species that are so prevalent in the Simuliidae, if such resolutions are possible.

This study was based largely on material available in the collection at the National Museum of Natural History, Smithsonian Institution (USNM), and that collected and reared by the author over the past several years. Holotypes, and other important supplementary material, were furnished from institutional and personal collections as listed in the acknowledgments. As a result, types of all the valid and synonymous species mentioned in the text have been examined.

To conserve space, distribution records are listed by state and county, in alphabetical order, followed by the earliest and latest collection dates within each county, and the life history stages of available material (A = adults, P = pupae, L = larvae). A complete list of locality data is available from the author upon request, and is on file at the National Museum of Natural History.

In the literature citations of the synonymies, I usually give the page number of the first occurrence of the name. However, in a few instances I give the page number on which the most important discussion or notation of the taxon appears. An effort was made to include as many references for each taxa as possible. Because it was impossible to examine representative specimens from all of the studies cited, I simply accepted the identifications of most authors. Consequently, I cannot vouch for the accuracy of many of their identifications. Obvious or suspected misidentifications are indicated in the appropriate places in the text.

Most of the illustrations used in this paper were prepared by various artists with the former 406th Medical General Laboratory, U.S. Army, Japan (see acknowledgments). A few of these apparently were made from pale specimens, or show features in a slightly different way or from a slightly different angle than described in the text. This does not negate either the figure or the description of such features in those few instances where such differences occur (e.g., some leg patterns, ventral view of ventral plate of the aedeagus, larval head capsules).

The scanning electron micrographs that accompany this paper were made from reared specimens stored in alcohol, dehydrated using a critical point dryer, and prepared for SEM study. Most of the micrographs were made using a Cambridge Stereoscan 100, while those at very high magnifications were made with either the Cambridge Steroscan 250 Mk 2, or the Hitachi Model 570. Micrographs were made of structures that were difficult to see under a dissecting or compound microscope. It was not always possible to obtain the same views of these structures, and micrographs of some parts could not be obtained.

The terminology employed in this study is essentially that used by Peterson (1981) with the few minor exceptions as described and used by Currie (1986).

TAXONOMIC TREATMENT

Genus *Simulium* Latreille
Subgenus *Psilopelmia* Enderlein

Psilopelmia Enderlein, 1934:283 (as genus). Type species: *Psilopelmia rufidorsum* Enderlein (original designation) = *Simulium escomeli* Roubaud (Vargas and Díaz Nájera, 1953a:146). Smart, 1945:465. Vargas, 1945c:101. Vargas and Díaz Nájera, 1957:158; Vargas and Díaz Nájera, 1959:110; Hidalgo Escalante, 1959:28; Stone, 1963:16; Stone, 1965:186; Vulcano, 1967:5. Rubtsov, 1968:358; Crosskey, 1969: 68; Rubtsov, 1974:276; Peterson, 1981:376; Coscarón, 1987:30; Crosskey, 1988: 433.

Lanea Vargas, Martínez Palacios and Díaz Nájera, 1946:103. Type species: *Simulium haematopotum* Malloch (orig. desig.). Vargas and Díaz Nájera, 1948a:69. Vargas and Díaz Nájera, 1948b:322. Vargas and Díaz Nájera, 1949:285. Vargas and Díaz Nájera, 1951a:130. Dalmat, 1955:69; Stone, 1963:11. Vulcano, 1967:5. Crosskey, 1988:466.

The literature cited in the synonymy includes only those papers that contain a characterization of the subgenus, include keys for distinguishing the various life history stages from those of other subgenera, or which include this subgenus in catalogs and lists.

The subgenus *Psilopelmia* has been amply characterized by Stone (1963), Coscarón (1987), and, to a much lesser extent, Crosskey (1969). The subgenus, based upon the species studied for this report, can be characterized as follows:

ADULTS: Basal section of R bare; Sc without setae ventrally. Thorax usually with at least some yellow or orange areas, and often densely pruinose, or with a bold dorsal pattern of one or more variably elongate, straight or curved stripes. Calcipala usually small and inconspicuous but may extend to or slightly beyond pedisulcus. *FEMALE:* Fronto-ocular triangle present; frons pruinose; cibarium with variably developed setalike or broader denticles. Hind tibia slender, without noticeable angle; hind basitarsus not widened; claw weakly curved, without a subbasal tooth but may have a fairly well developed heel. Lower margin of anal lobe not emarginate, either angulate or attenuate below and sometimes extended well below ventral margin of cercus. *MALE:* Gonostylus about ½ as long as gonocoxite, flattened, quadrangular, distal margin subtruncate with a variably prolonged or acute inner distal angle bearing a single short spine; base of paramere corrugated, arms with variably developed spines, apex of arms sometimes with a slender, wrinkled, membranous, rodlike process that extends internally from tips of arms of paramere (I have not seen this feature among other North American black flies). *PUPA:* Thorax usually but variably granulose dorsally. Abdomen with transverse rows of spines on more than tergites 2–4, those on 8 at least 16 in number; some dorsal spines on abdomen in contiguous comblike rows; terminal spines present but small; ventral spines present on sternites 4–6. Respiratory organ (gill), with 6–8 long, pale whitish to yellowish, slender filaments. Cocoon slipper-shaped, usually tightly woven with variably thickened anterodorsal margin. *LARVA:* Antenna pale, without annulations or transverse striations; cervical sclerites small, not strongly developed; hypostomal cleft broadly rounded, variably deep but never reaching base of hypstoma; mandible with 1 or 2 serrations on inner subapical margin. Anal setulae usually present but minute; posterior circlet

with less than 120 (usually less than 80) rows of hooklets; ventral tubercles usually present but small.

Keys to separate the adults and immature stages from those of other Mesoamerican subgenera can be found in the various papers of Vargas and Díaz Nájera listed above, and that of Dalmat (1955). Keys for the separation of the adults and larvae of this subgenus from other Nearctic taxa were given by Peterson (1981).

KEYS TO THE SPECIES OF THE SUBGENUS *PSILOPELMIA* IN THE CONTIGUOUS UNITED STATES

Females

1. Thorax, in lateral view, conspicuously arched dorsally and higher than normal, anterior face of scutum nearly vertical (Figs. 82, 95, 110, 112) 2
1.′ Thorax, in lateral view, not conspicuously arched dorsally or higher than normal, anterior face of scutum sloped upward and backward 3
2. Yellow to orange species, if black then thorax with distinct patches of yellow or orange color. Terminalia as in Figures 102, 121 ..... *robynae,* n. sp.
2.′ Entirely black species except postpronotal lobes yellow. Terminalia as in Figures 89, 120 ..... *labellei,* n. sp.
3. Scutum unicolorous, ground color yellowish to black, with a variably dense grayish pruinosity, without distinct stripes (stripes often discernible in alcohol preserved specimens) (Fig. 22) 4
3.′ Scutum with 1 to 7 distinct stripes (visible in both dry and alcohol preserved specimens) (Figs. 5, 39, 56, 70) 5
4. Scutum entirely to largely yellowish orange, at most with a faint pruinosity; legs entirely yellow; a small species, about 1.69 mm long. Terminalia as in Figure 51 ..... *notatum*
4.′ Scutum dark yellowish brown to black, densely grayish pruinose and often with a faint greenish yellow hue (Fig. 22); somewhat larger species, 1.82–3.25 (av 2.59) mm long. Terminalia as in Figure 26 ..... *griseum*
5. Scutum with a single, median, usually narrow, reddish to brown stripe, remainder of scutum rather uniformly brown to black with a dense grayish pruinosity (Figs. 39, 70) 6
5.′ Scutum with 7 alternating light and dark stripes, with grayish pruinosity only on the light stripes (Figs. 5, 56) 7
6. Anal lobe with, at most, a short, ventral convexity or lobelike process (Fig. 43b) (verified only from Texas) ..... *mediovittatum*
6.′ Anal lobe with a conspicuous, ventral, digitiform process (Fig. 77b) (more widely distributed) ..... *venator*
7. Dark stripes on scutum distinctly yellowish orange; a pale yellowish species (Fig. 5). Ventral digitiform process of anal lobe somewhat variable in length but not long enough for tips to cross in normal position (Fig. 10) ..... *bivittatum*
7.′ Dark stripes on scutum dark brown to black; a darker species (Fig. 56). Ventral digitiform process of anal lobe long, slender, with a tuft of apical setae, the processes of both sides somewhat variable in thickness but always long enough to cross each other in normal position (Figs. 61, 136) ..... *trivittatum*

Males

(Male of *notatum* not known)

1. Thorax, in lateral view, conspicuously arched dorsally, higher than normal, anterior face of scutum nearly vertical, top of head distinctly below top of thorax and often about on a level with top of scutellum (Figs. 111, 113) 2

1.′ Thorax, in lateral view, normal, not conspicuously arched or higher dorsally than normal, if conspicuously arched, then anterior face of scutum distinctly sloping posterodorsally, top of head often nearly as high as top of thorax 3

2. Pale brownish yellow species. Arm of paramere with 2 basal spines that are slightly stronger and more distinct than remaining parameral spines. Ventral plate of aedeagus, in ventral view, as in Figures 101, 119 ..... *robynae*, n. sp.

2.′ Black species. Arm of paramere with 4–5 basal spines that are stronger and slightly more distinct than remaining spines. Ventral plate of aedeagus, in ventral view, as in Figures 88, 118 ..... *labellei*, n. sp.

3. Thoracic ground color dark brown to black, strongly contrasting with submedian and lateral pruinose stripes; 2 submedian stripes bright grayish pruinose, that reach and merge with pruinosity of posterior declivity 4

3.′ Thoracic ground color variable; scutum without 2 submedian, grayish, pruinose stripes that reach pruinosity of posterior declivity; however, 2 variably developed but shorter, submedian, anterior pruinose spots may be present 5

4. Scutum with 2 large, submedian, triangular spots that strongly taper posteriorly and continue as 2 very slender, pruinose stripes that merge with pruinosity of posterior declivity. Ventral plate of aedeagus, in ventral view, broadly triangular with somewhat rounded lateral angles (Fig. 42). Arm of paramere with 2–4 (usually 2) strong, well defined, basal spines that are continuous with a distal cluster of 15 or more smaller, closely placed and less well defined spines among which may be 2–4 better defined spines that approach the basal spines in size and development ..... *mediovittatum*

4.′ Scutum with 2 broader, submedian, nearly straight or less tapered, pruinose stripes that merge with pruinosity of posterior declivity (Fig. 57). Ventral plate of aedeagus broadly subtriangular; in ventral view, lateral margins tapered distally to apical margin which, in flat view, is straight or slightly convex, or if basal arms somewhat tilted ventrally (inwardly) then apical margin curved with a short, broadly rounded, median point (Fig. 60). Arm of paramere with 4–5 basal spines that are much longer, broader, and better defined than apical spines ..... *trivittatum*

5. Thoracic ground color paler and more yellowish to orange brown; scutum, dorsally, matte black, at most faintly pruinose; viewed from in front with 2 outwardly curved, bright grayish pruinose, submedian, triangular spots that originate at posterior edge of anterolateral yellow area of scutum and extend posteriorly about ½–¾ distance to base of wing. Ventral plate of aedeagus, in ventral view, distinctly rectangular, with distal margin nearly straight to slightly curved. Arm of paramere with, at most, a few enlarged, basal spines, but these not conspicuously larger or better defined than apical spines (Fig. 9) ..... *bivittatum*

5.′ Thoracic ground color darker brown to black; scutum, dorsally, distinctly grayish pruinose, and submedian scutal spots, if present, much narrower and shorter. Ventral plate of aedcagus, in ventral view, subtriangular to subrectangular. Arm of paramere variable (Fig. 76) 6

6. Thorax black, with 2 short, submedian spots. Ventral plate of aedeagus, in ventral view, rather slender and subquadrate or, depending on angle of view, subtriangular and tapered distally to a point. Arm of paramere with a series of poorly defined spines, basal 3–4 of which are shorter, stouter, and better defined (Fig. 76) ..... *venator*

6.′ Thorax brown to black, densely grayish pruinose. Ventral plate of aedeagus, in ventral view, broad, subquadrate, with distal margin broadly rounded or nearly straight. Arm of paramere with 6–8 larger and well defined basal spines and 8–12 smaller, weaker, poorly defined spines (Fig. 25) ..... *griseum*

Pupae
(Pupa of *notatum* not known)

1. Thorax of pupa, in lateral view, distinctly separated from head, anterior face of thorax nearly vertical and projected dorsally well above level of top of head; anterolateral margin of thorax with a vertical row of about 4 conspicuous, multibranched trichomes on each side (Figs. 92, 93). Respiratory organ (gill) with 8 filaments 2

1.′ Thorax of pupa, in lateral view, nearly continuous with posterodorsal portion of head, anterior face of thorax variably curved dorsally and usually not projected as much above level of top of head (Figs. 16, 32, 80); if conspicuously projected dorsally above level of head (particularly male pupae) then anterolateral margin of thorax without a row of conspicuous multibranched trichomes. Respiratory organ with 6–8 filaments 3

2. Thorax with a multibranched trichome, similar to those on anterior face of scutum, just posterior to base of respiratory organ and just anterior to anteroventral angle of wing sheath; dorsal surface of thorax with 2 fanlike and 1–3 long single trichomes on each side. Head with numerous closely placed granules, these less numerous on dorsum of thorax ..... *labellei*

2.′ Thorax with 2–3 posterolaterally situated, dorsal trichomes that are long and simple or bifurcate. Head and thorax with numerous, tiny, closely placed granules ..... *robynae*

3. Respiratory organ with 6 filaments branching 2+2+2 (dorsal-ventral) (rarely with 7 filaments branching 3+2+2) ..... *trivittatum*

3.′ Respiratory organ with 8 filaments branching 3+3+2 (dorsal-ventral) 4

4. Respiratory organ with 3 groups of filaments branching (2+1) + (2+1) + 2 (dorsal, medial, ventral), the dorsal group on short petioles, the medial and ventral groups on longer petioles (Fig. 50). Anterior margin of cocoon with only a slightly thickened, narrow rim (Fig. 49) ..... *mediovittatum*

4.′ Respiratory organ with 2–3 groups of filaments, mediolateral group branching (1+2) not (2+1) as above (Fig. 17). Anterior margin of cocoon variable but usually distinctly thickened (Figs. 16, 32, 67) 5

5. Cocoon rather coarsely woven so that there often are distinct thicker and thinner areas, anterior margin only slightly thickened; in lateral view, anterolateral margin nearly straight but variably slanting anteromedially, anteroventral corners of cocoon variably produced inwardly and, at times, they meet or nearly so to produce a narrow, anteroventral collarlike lip or rim (Fig. 80). Tergite 5 bare; tergites 6–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, those of 6 sometimes reduced in number; this spine row of 6–7 separated by a median gap, but those of 8–9 complete; this row of 7 continuous laterally with a few much smaller, comblike spinules ..... *venator*

5.′ Cocoon more tightly and uniformly woven, without distinct thicker and thinner areas; anterior margin of cocoon distinctly thickened. Other characters not as above 6

6. Cocoon, in lateral view, with anterolateral margin nearly straight vertically or only slightly slanting so that anteroventral corner of cocoon usually extends only slightly in front of dorsal margin (Fig. 16). Tergite 5 bare except for a small patch of minute spinules anterolaterally; tergite 6 with several small comblike series of minute spinules that merge laterally with an anterolateral patch of even smaller spinules, numbers of both types of spinules variable ..... *bivittatum*

6′ Cocoon, in lateral view, with anterolateral margin slightly concave but distinctly sloping forward so that up to about ⅕ of its total length extends in front of dorsal rim (Fig. 32). Tergite 5 and usually 6 bare, but if spinules present on 6 then without an anterolateral patch of minute spinules ..... *griseum*

Larvae
(Larva of *notatum* not known)

1. Labral fan usually with fewer than 45 primary rays 2
1.′ Labral fan usually with 50 or more primary rays 5
2. Frontoclypeal apotome usually with light brown but generally distinct head spots (Fig. 11) (head spot pattern often resembles that of *S. venustum* Say complex); hypostomal bridge distinctly longer than hypostoma (more rarely subequal). Labral fan with 30–40 primary rays. Posterior circlet with 70 or more rows of hooks ..... *bivittatum*
2.′ Frontoclypeal apotome usually without distinct spots, if spots faintly visible, then hypostomal bridge either shorter or subequal in length to hypostoma. Labral fan with variable number of primary rays. Posterior circlet with variable number of rows of hooks 3
3. Antenna distinctly brown to pale brown except base of proximal and distal antennomeres, and apex of middle antennomere which are colorless. Hypostomal cleft, hypostomal bridge and hypostoma subequal in length. Labral fan with about 34–36 primary rays. Posterior circlet with 60–70 rows of hooks ..... *trivittatum*
3.′ Antenna faintly yellowish or faintly brownish on upper surface and transparent on lower surface. Hypostomal cleft, hypostomal bridge, and hypostoma variable in length. Posterior circlet with variable number of rows of hooks 4
4. Hypostomal cleft extended about ⅔ distance to base of hypostoma. Labral fan with 30–36 primary rays. Posterior circlet with about 60 rows of hooks ..... *griseum*
4.′ Hypostomal cleft extended over ½ distance to base of hypostoma. Labral fan with about 36 primary rays. Posterior circlet with 75–80 rows of hooks ..... *venator*
5. Antenna longer than stalk of labral fan by ½ or more length of distal antennomere; entirely pale yellowish. Posterior circlet with about 85–90 rows of hooks ..... *robynae*
5.′ Antenna at most slightly longer than stalk of labral fan; at least basal 2 antennomeres transparent whitish to colorless. Posterior circlet with fewer than 80 or more than 100 rows of hooks 6
6. Posterior circlet with about 68–76 rows of hooks. Basal 2 antennomeres colorless, distal antennomere faintly brownish ..... *mediovittatum*
6.′ Posterior circlet with about 110–116 rows of hooks. Antenna entirely transparent whitish ..... *labellei*

SPECIES DESCRIPTIONS

Simulium (*Psilopelmia*) *bivittatum* Malloch
Figs. 1–17

Simulium bivittatum Malloch, 1914:31 (♀, original description, key, catalog, fig. 7); holotype ♀, Type #15415 (USNM). Knab, 1914:83 (citation); Knab, 1915a (as 1914):179 (citation); Cole and Lovett, 1921:227 (biting bathers in Oregon); Cameron, 1922:4 (citation); Dyar and Shannon, 1927:37 (♀, key, description); Enderlein, 1930:96 (♀ head); Hearle, 1932:18 (citation); Knowlton, 1935:1073 (annoying horses); Essig, 1938:552 (biting bathers in Oregon); Knowlton, Harmston and Hardy, 1938:104 (Idaho); Twinn, 1938:54 (distribution in Idaho); Stains and Knowlton, 1943:278 (♀, ♂, key, description, figs. 81–82, 122–123, 125); Smart, 1945:502 (catalog); Vargas, 1945a:77 (♀ differentiated from *S. mangabeirai* Vargas); Vargas, 1945c:120 (catalog, synonymy, distribution); Knowlton and Fronk, 1950:5 (Utah); Pan Amer. Sanit. Bur., 1950:160 (literature reference (wrong reference cited, should be 770, not 769)); MacNay, 1954:156 (Saskatoon); MacNay, 1955:201 (Alberta); Peterson, 1955:114 (Utah); Fredeen, 1956:4 (Alberta); MacNay, 1956:291 (Al-

berta); Rubtsov, 1956:748 (citation); Fredeen, 1958:820 (Alberta); MacNay, 1958b: 272, (Saskatchewan, attacking horses); MacNay, 1958c:340 (Saskatchewan, attacking horses); MacNay, 1959a:41 (Saskatoon, annoying horses); MacNay, 1959b: 138 (Saskatoon, annoying horses); Peterson, 1959:151 (biting records); Peterson, 1960a:267 (predators); Peterson 1960b:99 (♀, ♂, pupa, key, distribution, type, type locality); Wiseman and Eads, 1960:46 (Texas records); Fredeen and Shemanchuk, 1960:729 (biological notes, Alberta); MacNay, 1961c:15 (Saskatoon, annoying horses); MacNay, 1962:179 (biting humans and animals, Alberta); Rubtsov, 1963: 531 (citation); Fallis, 1964:445 (feeding on horses); Jenkins, 1964:25 (reference to predators); Vulcano, 1967:7 (catalog, distribution); Travis, Lee and Labadan, 1969: 124 (biology); Shemanchuk and Depner, 1971:82 (trapping); Tipton and Saunders, 1971:11 (Utah); Hall, 1974:65 (California); Jones and Akey, 1977:374 (citation); Barnard, 1979:854 (in car top trap); Lacey and Mulla, 1979:88 (fig. 2, recovery rate); Chance and Craig, 1986:1297 (citation); Braimah, 1987a:504 (larval filter feeding); Braimah, 1987b:514 (larval filter feeding); Braimah, 1987c:2395 (larval feeding behavior); Smith and Rapp, 1987:136 (first record in Nebraska); Burger, 1987:138 (biology); Currie and Craig, 1988:159 (larva, fig. 3); Francy et al., 1988: 345 (possible vector of Vesicular Stomatitis virus New Jersey serotype); Service, 1988:196 (trapping); Pruess, 1989:433 (larval colonization on artificial substrates); Kramer et al., 1990:487 (harboring Vesicular Stomatitis virus New Jersey serotype). Crosskey, 1990:148 (citation).

Simulium (*Simulium*) *bivittatum,* Peterson and Wolfe, 1958:564 (Canada).

Simulium (*Neosimulium*) *bivittatum,* Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

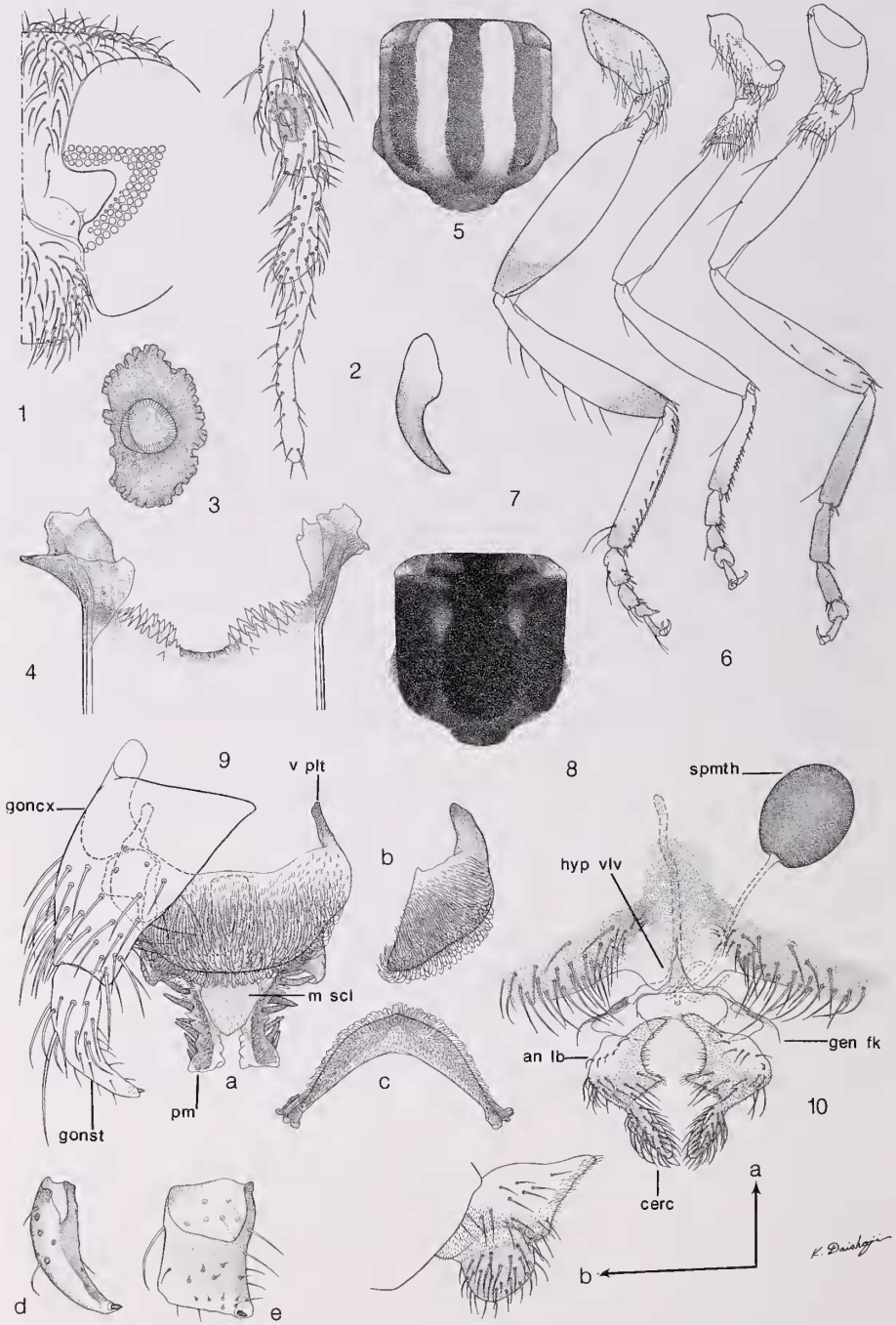
Simulium (*Lanea*) *bivittatum,* Vargas, Martínez Palacios and Díaz Nájera, 1946:138 (compared with *S.* (*L.*) *zempoalense* V., M.P. and D.N.); Wirth and Stone, 1956: 405 (♀, ♂, pupa, key, California);

Simulium (*Psilopelmia*) *bivittatum,* Vargas and Díaz Nájera, 1958:13 (♀, ♂, pupa, key, pupal and larval descriptions, figs. 1–16, notes); Anderson and Voskuil, 1963:127 (feeding on farm animals, California); Stone, 1965:186 (catalog, distribution); Abdelnur, 1968:125 (♀, ♂, pupa, larva, keys, Alberta); Cole, 1969:110 (brief description, distribution, biting); Díaz Nájera, 1969:31 (citation); Depner, 1971:1150 (biology, Alberta); Peterson, 1981:369 (♀, ♂, figs. 42, 62, generic and subgeneric key); Fredeen, 1985:15 (♀, ♂, pupa, keys, fig. 23, map 16); Shipp, 1985:1826 (biology, Alberta); Currie, 1986:41 (pupa, larva, keys, biology, figs. 111, 139, 178); Corkum and Currie, 1987:207 (biology immature stages); Coscarón, 1987:30 (list, distribution); Pruess and Peterson, 1987:530 (biology, distribution, Nebraska); Crosskey, 1988:466 (world list, distribution); Duque, Muñoz de Hoyos and Rothfels, 1988: 300 (citation).

Eusimulium clarum Dyar and Shannon, 1927:21 (♀, ♂, key, original description, figs. 38, 52–53); Lectotype ♂ (here designated) and 2 paralectotype ♂♂, Type #28336 (USNM). Hearle, 1932:9 (description, biology, British Columbia) (misidentification); Stains and Knowlton, 1943:266 (♀, ♂, key, description, figs. 27, 34–35, 55–56); Fitch, Swenson and Tillotson, 1946:216 (misidentification, feeding on nestling red-tailed hawks); Knowlton and Fronk, 1950:5 (Utah); Travis, Lee and Labadan, 1969:115 (biological notes).

Simulium (*Eusimulium*) *clarum,* Rubtsov, 1940:121 (citation); Peterson and Wolfe, 1958:564 (valid species, Canada).

Simulium clarum, Smart, 1945:503 (catalog, valid species); Vargas, 1945c:126 (cat-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alog, valid species, synonymy, distribution); Peterson, 1955:114 (syn. of *S. bivittatum,* Utah); Fallis, 1964:446 (feeding on long eared owl). Crosskey, 1990:415 (citation, but identity uncertain).

Simulium (*Lanea*) *clarum,* Vargas and Díaz Nájera, 1951a:149 (valid species).

Simulium (*Psilopelmia*) *clarum,* Stone, 1965:186 (catalog, syn. of *S. bivittatum*; California); Cole, 1969:110 (syn. of *S. bivittatum*); Crosskey, 1988:466 (syn. of *S. bivittatum*).

Simulium meridionale Malloch, 1914:49 (*clarum* in part; nec Riley, 1887) (apud Dyar and Shannon, 1927).

Simulium (*Simulium*) *idahoense* Twinn, 1938:50 (♂, original description, fig. 3a, b); holotype ♂, Type #4449 (CNC). Vargas, 1945a:77 (citation, ♂ syn. of *S. bivittatum*).

Simulium idahoense, Stains and Knowlton, 1943:278 (syn. of *S. bivittatum*); Smart, 1945:502 (catalog, syn. of *S. bivittatum*); Vargas, 1945c:120 (syn. of *S. bivittatum*).

Simulium (*Lanea*) *idahoense,* Vargas and Díaz Nájera, 1951a:149 (syn. of *S.* (*L.*) *bivittatum*).

Simulium (*Psilopelmia*) *idahoense,* Vargas and Díaz Nájera, 1958:13 (syn. of *S. bivittatum*); Stone, 1965:186 (syn. of *S. bivittatum*); Cole, 1969:110 (syn. of *S. bivittatum*); Crosskey, 1988:466 (syn. of *S. bivittatum*).

FEMALE. General body color bright yellow to yellowish orange, to brownish orange. Length: body, 2.3–3.3 (av 2.8) mm; wing, 2.2–2.7 (av 2.4) mm.

Head dark brown to black, densely silvery white pruinose on frons and clypeus, less dense on occiput. Frons moderately broad, at vertex about ⅔ as wide as at narrowest point, less than ½ width of head, and slightly wider than long; moderately covered with relatively long, decumbent, pale yellow pile. Clypeus concolorous or slightly lighter than frons; slightly longer than wide; moderately covered with relatively long, ventromedially directed pale yellow pile. Occiput densely covered with long, pale yellow pile; postocular setae pale, closely bent over eye margin. Scape and pedicel of antenna pale yellow to yellowish orange, usually concolorous or slightly lighter than flagellum which varies from pale yellow to brown; basal flagellomere slightly but distinctly longer than pedicel; fine pubescence pale yellow. Mandible with about 32–38 serrations. Blade of maxilla with 24–32 retrorse teeth. Palpus pale brown, palpomere 3 darkest; with pale yellow setae admixed with some brownish setae; palpomere 5 about ⅓ longer than palpomere 3. Sensory vesicle about ½ as long as its segment, proximally situated, its neck very short, arising middorsally and extended vertically, with a round mouth. Median proximal space of cibarium shallow, broadly U-shaped, with a shallow median depression and 2 sublateral lobes each bearing a series of short but usually conspicuous, stout seta-like denticles that sometimes extend

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Figs. 1–10. *Simulium bivittatum.* 1. Head of ♀. 2. Palpus of ♀. 3. Female sensory organ, enlarged. 4. Proximal end of ♀ cibarium showing armature. 5. Female thorax, dorsal view. 6. Hind, mid-, and fore legs of ♀. 7. Claw of ♀. 8. Male thorax, dorsal view. 9. Male terminalia: a. ventral view; b. lateral view; c. terminal (end) view; d. lateral view of gonostylus; e. inner view of left gonostylus. 10. Female terminalia: a. ventral view; b. lateral view. Abbreviations: an lb, anal lobe; cerc, cercus; gen fk, genital fork; goncx, gonocoxite; gonst, gonostylus; hyp vlv, hypogynial valve; m scl, median sclerite of aedeagus; pm, paramere; spmth, spermatheca; v plt, ventral plate of aedeagus.

part way across median depression; dorsolateral arm short, rather broad, heavily sclerotized.

Thorax pale grayish yellow to yellowish orange laterally and brownish yellow to brownish orange dorsally. Postpronotum pale yellow to yellowish orange, distinctly paler than scutum, sometimes pruinosity of thoracic vittae extends onto all or part of postpronotal lobe; covered with moderately long, semi-erect to erect, pale yellow pile. Scutum with 7 alternating stripes, median and sublateral stripes of yellowish to brownish orange ground color, median stripe reaching anterior margin, sublateral stripe extended to base of postpronotal lobe; median stripe ending posteriorly at anterior edge of posterior declivity; sublateral stripe extended to near anterolateral angle of scutellum; submedian and lateral stripes bright silvery white pruinose, submedian stripe united with pruinose posterior declivity, lateral stripes usually extended to hind margin of notopleural ridge but sometimes extended to, and united with, posterior declivity; pollinose stripes anteriorly sometimes extended, in varying densities, over all or portions of postpronotal lobes essentially surrounding dark sublateral stripes; scutum moderately covered with short, recumbent, pale yellow (golden yellow in some views) pile which is longer along lateral margin and still longer and semi-erect to erect posteromedially. Scutellum yellow to yellowish orange; densely covered with long, pale yellow setae. Postnotum brownish black to black, with a light silvery white pruinosity, and often with a faint to distinct, narrow, median yellowish basal spot or longitudinal line. Pleuron usually pale grayish yellow but sometimes brownish orange, moderately pruinose; katepisternum usually brown to brownish black, sometimes mottled with yellow or rarely entirely yellow or orange; anepisternal membrane pale grayish yellow, lightly pruinose; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins yellowish; base of costa and stem vein with pale yellow setae, rest of setae on veins pale yellow, spinules black; fringe of calypter and anal lobe pale yellow. Halter pale yellow, with pale pile.

Legs: Foreleg yellow to orange yellow, base of first tarsomere sometimes yellow otherwise all tarsi brown to black, slightly swollen. Midleg with coxa yellowish brown to brown, femur, tibia and basal ¾ of 1st tarsomere and basal half of 2nd tarsomere yellow, rest of tarsomeres brown to black. Hind leg with coxa yellowish brown to brown, femur yellow, browned on about apical ¼, tibia yellow, browned on apical ¼ to ⅓, 1st tarsomere yellow, brown on about apical ¼, 2nd tarsomere yellow on basal ½ (including pedisulcus), remainder and apical tarsomeres brown to black; hind basitarsus about 5 or 6 times as long as broad; calcipala small, inconspicuous; pedisulcus small, inconspicuous, but deep. Claw simple, evenly but not strongly curved from base.

Abdomen largely grayish yellow, sometimes more brownish orange, terminal segments dorsally and pleural membranes more grayish; basal scale (tergite 1) pale yellow, with a fringe of long pale yellow pile; tergites 2–6 dark matte brown, these slightly increased in size posteriorly; pleural membrane of segments 3 and 4 each with an irregular dark mark; abdomen moderately covered with mostly short, recumbent, pale yellow pile; sternites 1–7 weakly sclerotized, often difficult to discern, sparsely covered with short, pale setae; sternite 8 more heavily sclerotized, dark brown, with long, mostly yellow setae interspersed with some dark brown setae.

Terminalia as in Figure 10. Anal lobe broad dorsally, slightly broadened ventrally to just below ventral margin of cercus where there is a varyingly prominent bulge at its posterior edge, then tapers obliquely anteriorly to a moderately long, slender,

fingerlike process that is about ⅓ as long as total height of anal lobe; anal lobe moderately setose, digitiform process covered with short, fine setae. Cercus prominent, subrectangular, slightly higher than long, hind margin strongly rounded, moderately setose. Hypogynial valve rather short, not extended to anterior margin of cercus, each valve with a short median lobe that is bare and weakly sclerotized and often difficult to see, medial margins of lobes diverge obliquely, and sparsely microsetose basally. Stem of genital fork long, heavily sclerotized, about 3 times longer than arms; arm short, weakly sclerotized, with a prominent rounded lobe at inner distal corner, and a narrow, heavily sclerotized ridge along proximal margin and with a long, slender toothlike process at inner proximal angle; arm narrowly attached to segment 9. Spermatheca subglobular, heavily sclerotized, with a faint reticulate pattern.

MALE: General body color velvety brown to black, thorax dorsally variously marked with yellow or orange. Length: body, 2.4–3.0 mm; wing, 1.8–2.1 mm.

Clypeus densely grayish pruinose. Occiput, lower marginal area between eyes, and frons with long, brownish or black setae; clypeus with erect, yellow pile. Scape, pedicel and basal half of first flagellomere yellow, rest of antenna brown to black; first flagellomere slightly longer and more narrow than pedicel; fine pubescence pale yellow. Palpomere 3 black, 4 and 5 grayish brown, all with black pile; palpomere 5 slightly less than 3 times longer than palpomere 3. Sensory vesicle small, globular, about ⅙ to ¼ as long as its segment; neck short, indistinct, with a small round mouth.

Prescutum black. Postpronotum yellow, concolorous with anterolateral corner of scutum, with long, pale yellow pile. Scutum varying from entirely black to reddish brown, and with varying amounts of yellow or orange; usually black with anterolateral corner yellow and a central black portion that reaches anterior margin, lateral margin and most of notopleuron rather broadly yellow and grayish pruinose, extended to near base of wing; posterior declivity varying from all black and densely grayish pruinose to having varying amounts of orange or yellow to being entirely yellow roughly in an M-shape; scutum when viewed from in front, with an outwardly curved, bright grayish pruinose mark originating at posterior edge of anterolateral yellow area of scutum and extended posteriorly to about half distance to base of wing; scutum densely covered with recumbent, golden yellow pile that is longer anteriorly and laterally, posterior declivity with long, erect to semi-erect yellow pile some of which is directed anteriorly. Scutellum varying from yellow to dark yellowish brown, distinctly paler than scutum; densely covered with long, yellow setae. Postnotum brownish black, grayish pruinose, contrastingly lighter than velvet black of scutum. Pleuron black, mesepimeron mottled with yellow below wing base and behind midcoxa; anepisternal membrane yellow to brown; mesepimeral tuft yellow.

Wing membrane hyaline, veins pale yellowish; base of costa and stem vein with yellow pile, rest of setae on veins black; fringe of calypter and anal lobe yellow. Halter pale yellow with yellow pile.

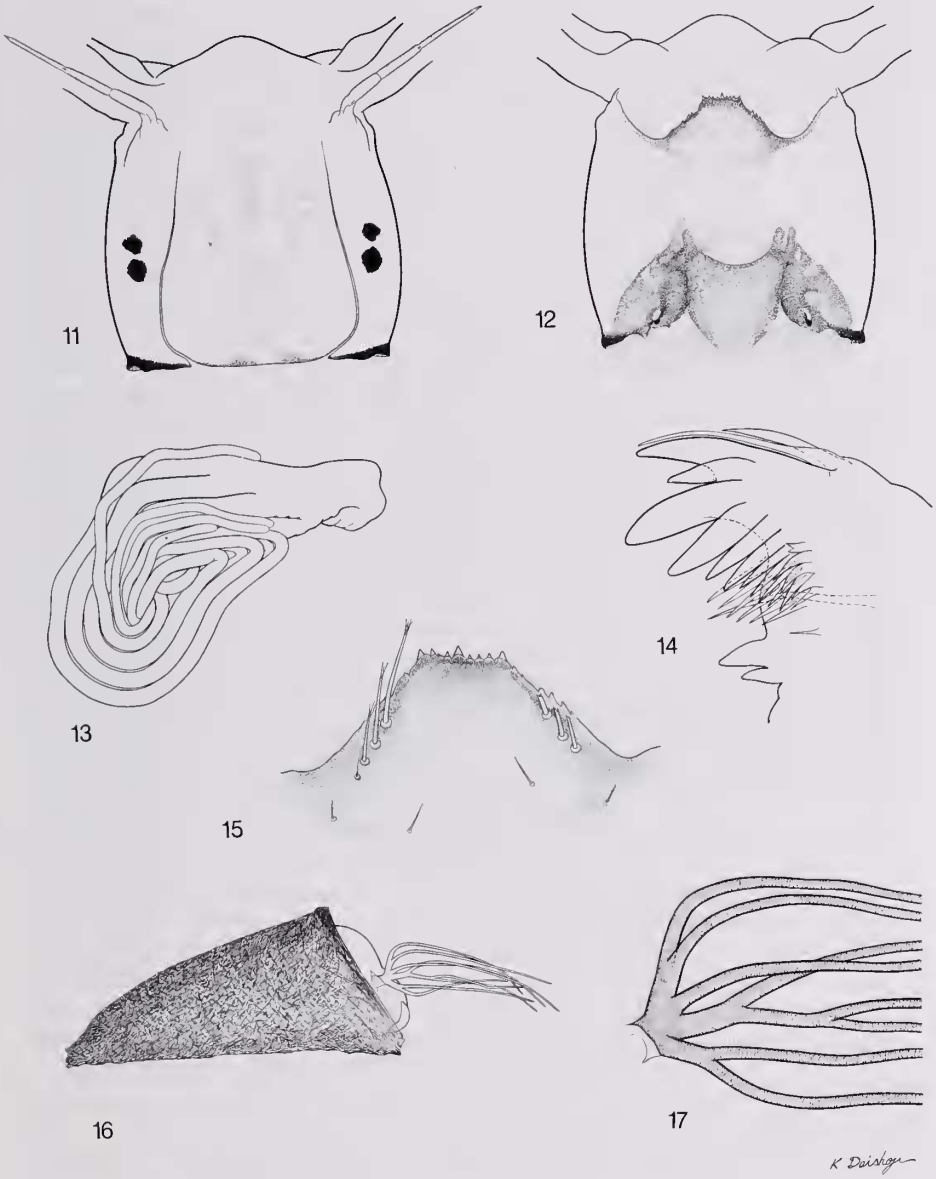
Legs, especially hind leg, somewhat variable in color. Foreleg usually yellow except for black tarsus, sometimes coxa, trochanter and dorsal surface of femur and tibia brownish and apex of tibia with a narrow brown ring. Midfemur, tibia, basal ¾ of basitarsus and basal half of second tarsomere yellow, remaining portions brown to black. Hind leg usually with basal ⅘ of femur, basal ½ of tibia, basal ¾ of basitarsus, and basal ½ of second tarsomere yellow, remainder of segments black, sometimes hind femur entirely black. Yellow portions of all tibiae with a dense grayish pruinosity;

all yellow portions of legs with yellow setae and dark portions with black setae; hind femur and tibia with some long, black setae along posterodorsal margin; when hind femur entirely black it is variably covered with black and yellow setae. Hind basitarsus not swollen, about 5 times as long as broad, calcipala short, extended about ⅓ distance to pedisulcus; pedisulcus deep but not conspicuous. Claw short and slender.

Abdomen with tergites black and remaining portion largely grayish yellow; basal scale with a fringe of long, pale yellow pile; tergite 2 with a narrow central black portion and lateral portion yellowish with a dense grayish pruinosity; tergites 3–5 and 9 velvety; tergite 6 varying from having same color pattern as tergite 2 to being entirely black but in all cases entirely densely grayish pruinose; tergites 7–8 velvety dorsally and densely pruinose laterally, pruinosity of tergite 8 confined to lateral edges; tergite 10 small, rectangular, about ⅔ broader than long; dark portions of tergites with mostly short, black setae and occasionally with a few longer pale yellow setae intermixed; yellow and pruinose portions of tergites and pleural membrane with longer, yellow setae. Sternites 2–3 weakly sclerotized, pale yellow; anterior portions of sternites 4–8 brown to black, posterior portions yellow, with a few short black setae.

Terminalia as in Figure 9. Gonocoxite subconical, tapered distally, greatest width and length nearly equal, sparsely setose on distal half. Gonostylus subquadrate, short, only slightly longer than greatest width at base, sparsely covered with long setae, apical margin with outer distal corner rounded and inner distal corner produced as a short, narrowly rounded process bearing 1 small spine. Ventral plate of aedeagus broadly rectangular, about ¼ broader than long; in ventral view, body widest at junction with basal arms, tapered distally, apical margin nearly straight to slightly rounded but may have medial portion nearly straight, basal arm straight to slightly bowed, short, body and basal arms nearly equal in length, proximal margin between arms broadly concave; ventral plate, in lateral view, with short ventral lip whose ventral face is nearly straight; ventral surface densely covered with short setae. Median sclerite of aedeagus short, stem slightly longer than arms; arms short and imperfectly separated, distal margin of each arm oblique with a narrow, sclerotized ridge. Aedeagal membrane densely covered with minute, pale, irregular, ridgelike cuticular thickenings arranged in vaguely comblike series, these clearly visible only at magnifications of about 200× or more; when viewed at 400× they appear to consist of a series of minute setulae. Basal plate of endoparameral organ where it attaches to inner margin of outer corner of gonocoxite, subrectangular and bearing a series of conspicuous sclerotized, ridgelike thickenings (appearing corrugated or similar to a leaf with strong veins); arm about 2½ times as long as basal plate, bent medially at about a right-angle from basal plate and extended internally for a short distance and then curved posteriorly at nearly another right-angle so that arms of both parameres approach medially and run parallel distal to median sclerite of aedeagus; arm of paramere composed of 20 or more poorly defined and irregularly sized teeth and teethlike corrugations.

PUPA. Length 2.2–3.6 (av 2.7) mm. Respiratory organ (gill) (Fig. 17) 1.7–2.2 (av 1.9) mm long, usually distinctly shorter than pupa; consisting of a short, rather slender base covered with minute spicules, and 8 filaments arranged in 3 groups whose branching pattern is somewhat variable but usually as follows: a ventral group of 2 filaments on a long petiole, a dorsal group branching (2+1) (dorsal-ventral) on a



Figs. 11–17. *Simulium bivittatum.* 11. Head capsule of larva, dorsal view. 12. Head capsule of larva, ventral view. 13. Respiratory histoblast of mature larva. 14. Tip of mandible of larva. 15. Hypostoma of larva. 16. Cocoon and pupa, lateral view. 17. Basal portion of respiratory organ (gill) of pupa.

short petiole, and a mediolateral group branching (1+2) (d-v) on a petiole subequal to ventral group; filaments varying from yellowish brown to whitish gray, slender, with numerous shallow annulations. Integument of head and thorax with numerous, raised granules, these slightly larger and coarser than in *griseum*; antennal sheath of male reaching about ½ distance to hind margin of head; antennal sheath of female just short of reaching hind margin of head by about length of apical antennomere; clypeus with a long, fine, pale, simple or bifurcate, submedian seta just ventral and medial to base of each antenna. Dorsum of thorax with 4–8 long, slender, simple or bifurcate trichomes that are pale and often difficult to see; usually 2 long, slender, pale, simple or bifurcate setae just anterior to base of wing sheath and with 1 similar seta slightly more dorsal near base of respiratory organ. Chaetotaxy of each lateral half of tergites as follows: abdominal tergite 1 with 2–5 short, pale whitish lateral setae; tergite 2 with 4 short, simple, hooklike setae and 1 more lateral and 1 more anterolateral setae, and with a small patch of minute spinules anterolateral to these setae; tergites 3 and 4 each with 4 stout, anteriorly directed spines along posterior margin and with 1 small seta anterior to hooks and 3–5 setae lateral to hooks; tergite 5 bare except for a very small patch of minute spinules anterolaterally; tergite 6 with several small series of minute, comblike spinules that merge laterally with an anterolateral patch of more minute spinules, numbers of spinules of both types variable; tergites 7–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, that of tergite 7 variably developed and with a broad gap medially, while those of tergites 8–9 complete, rows of spinules on latter 3 tergites continuous laterally with a variably sized patch of minute spinules; caudal spines small, straight, tips slightly convergent, each situated on a slightly swollen convexity. Chaetotaxy of each lateral half of sternites as follows: sternite 3 with a single, tiny submedian seta; sternite 4 with 1 small, slender, submedian hook and a tiny seta lateral and another anteromedian to it; sternites 5–7 each with 2 longer, rather slender, bifid to trifid hooks, those of 5 submedian and close together while lateral hooks of sternites 6–7 more widely separated but not lying in pleural membrane; sternites 8–9 bare. Cocoon slipper-shaped, densely woven, anterior margin narrowly but distinctly thickened; in lateral view, anterolateral margin of cocoon nearly straight vertically or slightly slanting so that anteroventral corner of cocoon extends only slightly in front of dorsal margin, floor well developed and extended anteriorly about ½ length of cocoon.

LARVA. Length 3.72–4.92 (av 4.42) mm. Body color grayish white marked with patches of darker gray dorsally on abdominal segments and nerve cord ventrally; dorsal intersegmental lines rather broad, slightly paler than rest of abdomen. Head capsule (Figs. 11, 12) varying from pale yellow to brown with an underlying yellow tinge; pale form (probably due to length of time from previous molt) with mandibular phragma and postocciput brown, and variably brown on upper area of gena near eye spots and ventrally on hypostomal bridge; darker form with head capsule more uniformly brown and head spots distinctly yellow; anteromedian and posteromedian dorsal head spots rather widely separated; anterolateral spots 1 and 2 small, less distinct and more narrowly separated; posterolateral spot 1 small, slightly darker and separated from posterolateral spot 2 which is larger, yellow anterolaterally and darkened posteriorly and medially; frontoclypeal apotome anterior to head spots pale yellow only to about level of base of stalk of labral fan and then variably brownish medially to anterior margin and with anterolateral margins pale yellow, sometimes entire area anterior to head spots pale yellow; eye spots small and dark, area sur-

rounding them and extended from mandibular phragma to postocciput pale yellow. Antenna slightly longer than stalk of labral fan; basal 2 antennomeres faintly brownish dorsally, pale whitish and transparent ventrally; antennomere 3 slightly darker grayish brown except base which is narrowly white; proportions of antennomeres about 5:8:8 (basal to apical). Labral fan with about 30–45 primary rays. Hypostoma as in Figure 15; apical margin nearly straight to slightly concave, median tooth and outer lateral teeth nearly equal in length; usually with 4 sublateral teeth 1 of which is very tiny; and with 3 long and 1 short hypostomal setae along lateral margin, and a sublateral pair of setae posteriorly. Hypostomal cleft deep, extended about ½ distance to base of hypostoma, broadly rounded to slightly pointed apically, length slightly more than greatest width. Hypostomal bridge slightly but distinctly longer than hypostoma. Mandible with 4–5 apical teeth of varying sizes and an erect toothlike process that diverges at about 90° from near base of apical teeth, this process slender and toothlike in some views and fanlike in other views; with about 7 comb teeth; subapical ridge with 2 fine, closely placed, distal serrations, distalmost serration longest. Maxillary palpus nearly parallel sided, 3.0–3.5 times as long as width at base. Lateral plate of proleg broad, a somewhat irregular rectangular to subquadrate or an inverted boot-shape, lightly sclerotized and difficult to see, extended about ¾, or slightly more, length of apical segment; circlet of apical hooks placed in about 28+ rows. Anal setulae very small and requires high magnification (100× or more) to see, sparse, and scattered laterally between arms of anal sclerite and between this sclerite and posterior circlet of hooks; anal papillae consisting of 3 simple (sometimes weakly compound) lobes, outer lobes separated at base from that of median lobe and with a small convexity situated between each lateral and median lobe, lateral lobes diverging from median lobe; abdomen with 2 small, barely noticeable, ventral tubercles. Arms of anal sclerite broadly joined medially, anterodorsal arm broad and pointed apically, slightly shorter and not as heavily sclerotized as posteroventral arm; posteroventral arm slender and tapered to a fine point apically. Posterior circlet of hooks consisting of about 12–17 hooks in 70+ rows.

REMARKS: Some tergites of the pupa have anterolateral patches, of variable size, of very minute spinules. A vague roughness in this area can be seen with a dissecting scope but the spinules are better seen under a compound microscope. The pupae I have examined of *S. griseum* do not have these patches of minute spinules, although more specimens than were available to me should be studied to test if this is a consistent character difference.

Dyar and Shannon (1927) described *Eusimulium clarum* from 15 specimens including the four females and three males they considered to be the type series. They described the female first and likened it to both *Eusimulium johannseni* (Hart) and their own *E. minus,* which was probably the reason that they described *clarum* as a species of *Eusimulium.* Fortunately, Dyar and Shannon designated the three males as the 'types' (cotypes), and the four females as paratypes. The males definitely are *bivittatum* and thus *clarum* can be clearly synonymized with *bivittatum.* Because I cannot locate any of the female paratypes, I cannot say if they are the same or a different species, or if they belong to *Eusimulium* or some other supraspecific group. Stone labelled, in pencil, the following slide mounted male as lectotype but, to my knowledge, never published this designation. This specimen, here designated as the lectotype of *clarum,* has the following data: Fresno, California, May 12, 1923, M. E. Phillips. The terminalia are clearly evident.

Simulium idahoense was described by Twinn (1938) on the basis of 33 male specimens. The holotype was, ". . . taken at light, . . ." Riverdale, Idaho, September 2 (as II.IX, 1934), by C. F. Smith, and the 31 paratypes were from the same locality but collected on various dates ranging from late August to September, 1934, by C. F. Smith and G. F. Knowlton. One paratype was taken at Preston, Idaho, September 13, 1934, by C. F. Smith. Twinn noted that this species, ". . .may prove to be the undescribed male form of *S. bivittatum* Malloch, ..." Stains and Knowlton (1943) synonymized this species with *bivittatum* based on a long series of females from the type locality, and other specimens of both sexes that were taken together. Smart (1945) accepted this synonymy as did the other authors listed in the synonymical list above. The holotype male is mounted on a slide, with the body and wings under one coverslip, and the genitalia under another. Both gonocoxites and gonostyli are easily seen, but the aedeagal-parameral complex is squashed and obscured. The ventral plate is flattened and overlain by the also flattened parameres and consequently all the parts are not fully visible. However, after examining the type and 11 pinned paratypes, I can confirm the synonymy of *idahoense* with *bivittatum*.

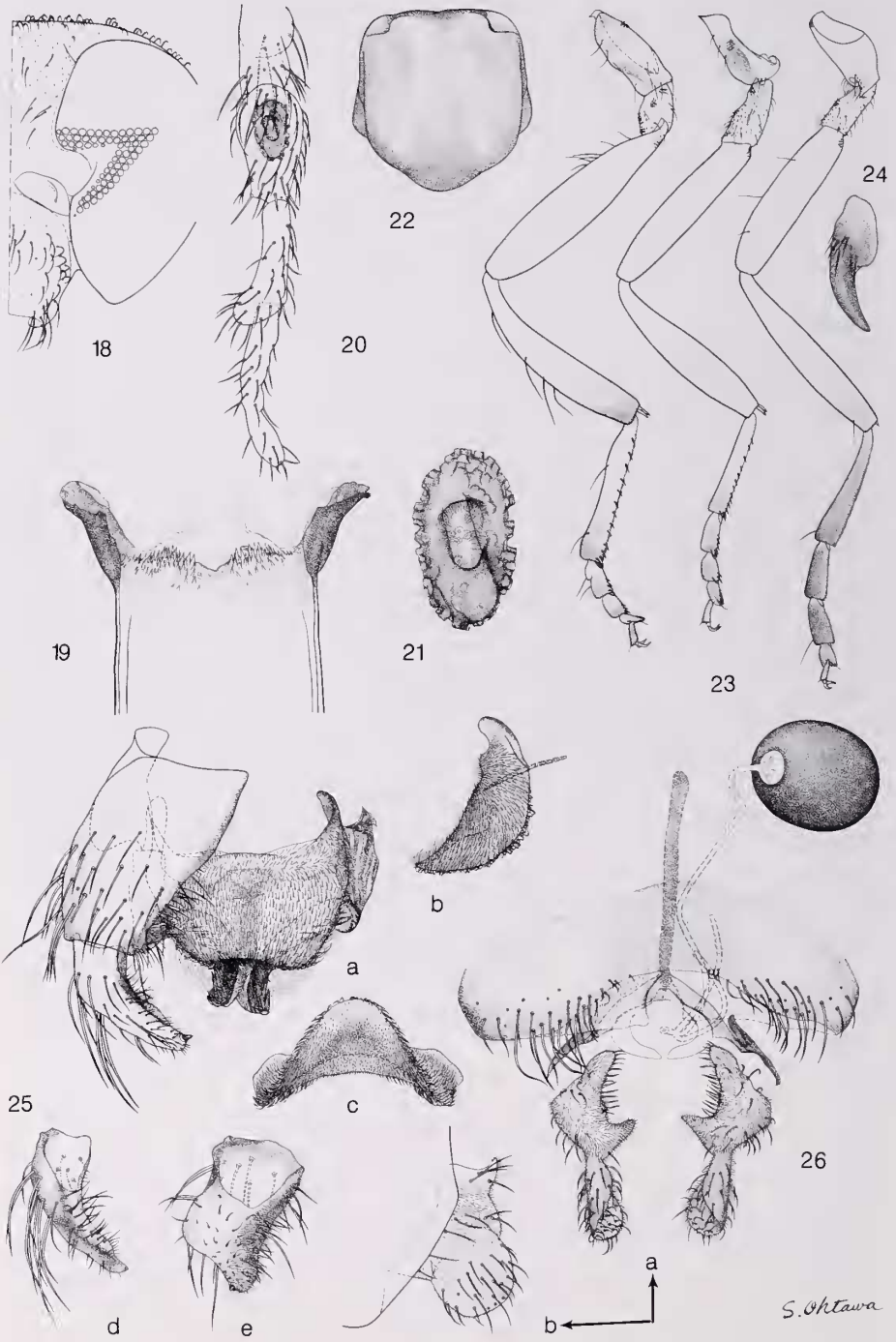
SPECIMENS EXAMINED (total—1,240 males; 2,586 females; 125 pupae and pupal pelts; 1,703 larvae): ARIZONA: *Coconino Co.*, June 29, (A). CALIFORNIA: *Fresno Co.*, May 12–24, (A) (includes lectotype and paralectotypes of *clarum*). *Inyo Co.*, July 9–September, (A). *Kern Co.*, June 29–July 29, (A). *Riverside Co.*, May 25–August, (A). *Sacramento Co.*, August 21, (A). *San Bernardino Co.*, April (A). *Tulare Co.*, June 9–July 1, (A). COLORADO: *Adams Co.*, August 1, (A). *Boulder Co.*, August 23–October 23, (A). *Larimer Co.*, May 24–November 1 (A) (includes paratypes). *Mesa Co.*, July 29–August 13 (A). *Pueblo Co.*, July, (A). *Weld Co.*, March 21–October 15, (A). IDAHO: *Bannock Co.*, July 22–September 15, (A). *Elmore Co.*, August 9, (A). *Franklin Co.*, August 24–September 15, (A) (includes paratypes of *idahoense*). *Jefferson Co.*, July 29, (A). *Madison Co.*, July 19–20, (A). *Nez Perce* Co., May 11, (A). *Twinn Falls Co.*, June 23–August 6, (A). MONTANA: *Cascade Co.*, July 7, (A). *Yellowstone Co.*, June 22, (A). NEBRASKA: *Blaine Co.*, 27, (P, L). *Brown Co.*, May 13–October 10, (A, P, L). *Cherry Co.*, May 27, (L). *Franklin Co.*, May 9, (L). *Gage Co.*, June 20, (P). *Keith Co.*, May 11–17, (A, P, L). *Lincoln Co.*, May 17–August 11, (A, L). *Loup Co.*, May 13–November 11, (A, P, L). *Nemaha Co.*, August 30, (L). *Saunders Co.*, August 13, (L). *Scotts Bluff Co.*, August 15, (L). *Sioux Co.*, May 22–June 9, (A). *Webster Co.*, March 22–August 30, (A, P, L). NEW MEXICO: *Catron Co.*, June 24, (A). *Colfax Co.*, July 1–4, (A). *Grant Co.*, June 24, (A,P). *Lincoln Co.*, May 7, (P, L). *Mora Co.*, August 17, (A.P). *Rio Arriba Co.*, July 12, (L). *Sandoval Co.*, July 4, (A). *San Miguel Co.*, August 16–19, (A) (includes paratypes). *Sierra Co.*, October 20, (A, P). *Taos Co.*, July 6, (A). OREGON: *Malheur Co.*, August 7, (A). SOUTH DAKOTA: *Lawrence Co.*, July 28, (A). TEXAS: *Collin Co.*, March 28, (A). *Menard Co.*, May 22, (A). UTAH: *Beaver Co.*, August 4, (A). *Box Elder Co.*, July 16, (A). *Cache Co.*, August 14, (A). *Garfield Co.*, July 3, (L). *Kane Co.*, July 18, (P, L). *Morgan Co.*, July 14–September 23, (A). *Salt Lake Co.*, August 1 , (A). *Summit Co.*, July 1–August 14, (A, P, L). *Wasatch Co.*, July 17–August 25 (A). *Washington Co.*, June 22, (A). *Weber Co.*, July 28–September 9, (A). WASHINGTON: *Garfield Co.*, September 23, (A). *Kittitas Co.*, July 22, (A). *Yakima Co.*, May 19–August 17, (A). WYOMING: *Carbon Co.*, 1986, (A). *Niobrara Co.*, July 21–August 22, (A). *Park Co.*, August 22, (A). *Platte Co.*, August 18, (A). *Sweetwater Co.*, July 7–25, (A).

PREVIOUS RECORDS: CANADA: Alberta, Saskatchewan. U.S.: Arizona, California, Colorado, Idaho, Nebraska, Nevada, New Mexico, Montana, Oregon, South Dakota, Texas, Utah, Washington, Wyoming. MEXICO: Zacatecas.

BIOLOGICAL NOTES: The immature stages of *S. bivittatum,* like most North American species of *Psilopelmia,* are common in clean, warm to cool, relatively stable streams where they most frequently are found on trailing vegetation (Pruess and Peterson, 1987; Pruess, 1989). However, they have been collected by the author from submerged branches, rocks and trailing pieces of rope in southern Alberta and Utah. The immature stages also occur in irrigation ditches and other 'milky' type streams and rivers, but I have not found them to be nearly as numerous in such habitats. Aspects of filter feeding by the larvae have been discussed by Braimah (1987a, b, c). I have examined numerous adults, of both sexes, collected in light traps set up by Wayne Kramer in pasture areas and near barns in eastern Colorado. The females are pests of horses and cattle throughout the low foothill and prairie areas of the western states and western Canada. There are reports of females biting horses and other farm animals (Knowlton, 1935; Twinn, 1938; MacNay, 1958b, c, 1959a, 1961c, 1962; Anderson and Voskuil, 1963; Fallis, 1964), and mixed populations of *S. bivittatum* and *S. griseum* biting horses, cattle and man (Fredeen and Shemanchuk, 1960; Fredeen, 1981). There are specimens in the USNM collection labeled as biting horses and cows from California, Nevada, Utah and Wyoming. This species also has been reported as feeding on, or annoying man (Cole and Lovett, 1921; Essig, 1938; MacNay, 1962; Cole, 1969). There are even records of this species (as *Eusimulium clarum*) feeding on nestling red-tailed hawks (*Buteo jamaicensis* (Gmelin)) (Fitch et al., 1946; Fallis, 1964), and on the head of a young long-eared owl (*Asio wilsonianus* (Lesson)) (Hearle, 1932; Fallis, 1964). I am unable to confirm these bird feeding records and suspect they are based upon misidentified specimens. Francy et al. (1988) mentioned the presence of *S. bivittatum* among voucher specimens taken in Colorado, that were in a collection of species that formed a pool of several species that tested positive for Vesicular Stomatitis virus. Kramer et al. (1990) also reported the presence of Vesicular Stomatitis New Jersey virus in females of *S. bivittatum* in eastern Utah and western Colorado. This species apparently overwinters in the egg stage over most, if not all, of its range. However, the overwintering period may be much shorter in the extreme southern and drier parts of its range. Some other aspects of the biology of this multivoltine species have been discussed by Peterson (1959), Depner (1971), Lacey and Mulla (1979), Shipp (1985), Burger (1987), Currie (1986), Corkum and Currie (1987), Pruess and Peterson (1987), and Pruess (1989).

Simulium (*Psilopelmia*) *griseum* Coquillett
Figs. 18–33, 122–125

Simulium griseum Coquillett, 1898:69 (♂, ♀, original description in key); Holotype ♂, 3 ♀♀ paratypes, Type #10381 (USNM). Johannsen, 1903:361 (♂, ♀, description, list, key); Aldrich, 1905:168 (catalog); Emery, 1914 (as 1913):348 (list, key); Malloch, 1914:52 (♂, ♀, key, catalog); Knab, 1915b:78 (♂, ♀, compared with *mediovittatum* Knab); Dyar and Shannon, 1927:35 (♂, ♀, description, key, distribution, figs. 90–91, 94–96); Enderlein, 1930:96 (citation); Stains and Knowlton, 1943:278 (♂,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d
e
a
b
S. Ohtawa

♀, description, key, distribution, figs. 83–84, 118–119, 128); MacNay, 1944:93 (citation); Smart, 1945:505 (catalog); Vargas, 1945c:141 (catalog, synonymy, distribution); Strickland, 1946:158 (Alberta); Knowlton and Fronk, 1950:5 (Utah); MacNay, 1952:333 (Alberta; irritating to man and livestock); MacNay, 1953:37 (Alberta); Edmunds, 1954:65 (biology, Nebraska); MacNay, 1954:156 (Saskatoon); Peterson, 1955:114 (Utah); Fredeen, 1956:4 (Alberta, Saskatchewan); Lindquist and Knipling, 1957:190 (biology, Nebraska); Fredeen, 1958:820 (Alberta, Saskatchewan); MacNay, 1958a:244 (attacking horses, Saskatoon); Peterson, 1958: 153 (Utah); Bacon and McCauley, Jr., 1959:108 (citation); Fredeen, 1959:82 (citation); MacNay, 1959a:41 (Saskatoon, annoying horses); MacNay, 1959c:187 (Saskatoon, annoying horses); MacNay, 1959d:289 (Saskatoon, annoying horses); Fredeen and Shemanchuk, 1960:730 (biology, Alberta); Jones, 1961:114 (in bait traps, Colorado); MacNay, 1961a:290 (Saskatoon, annoying man and animals); MacNay, 1961c:305 (Saskatoon, annoying man and animals); Ryckman, 1961:405 (feeding on jackrabbits, California); Fredeen, 1964:109 (biology); Travis, Lee and Labadan, 1969:128 (citation, biology); Newell, 1970:47 (Montana); Hannay and Bond, 1971a:543 (wing surface structure); Shemanchuk and Depner, 1971:32 (citation); Tipton and Saunders, 1971:11 (Utah); Fredeen, 1973:5 (biting humans and animals, Alberta, Saskatchewan); Hall, 1974:65 (citation, California); Fredeen, 1977:224 (biology, Alberta); Jones et al., 1977:443 (biting horses); Smith and Rapp, 1987:136 (Nebraska); Burger, 1988:138 (citation).

Simulium (*Simulium*) *griseum,* Peterson and Wolfe, 1958:564 (Canada).

Simulium (*Neosimulium*) *griseum,* Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

Simulium (*Lanea*) *griseum,* Vargas, Martínez Palacios and Díaz Nájera, 1946:107 (citation); Vargas and Díaz Nájera, 1951a:149 (citation); Wirth and Stone, 1956: 405 (♂, ♀, key, California).

Simulium (*Psilopelmia*) *griseum,* Peterson, 1960b:100 (♂, ♀, pupa, keys, types, type locality, distribution, Utah); Stone, 1965:187 (catalog, distribution); Abdelnur, 1968:125 (♂, ♀, pupa, larva, key, Alberta); Cole, 1969:110 (citation, distribution); Depner, 1971:1151 (biology, Alberta); Fredeen, 1985:15 (♂, ♀, pupa, keys, fig. 23, map 17, Saskatchewan); Shipp, 1985:1826 (distribution, Alberta); Currie, 1986: 42 (larva, pupa, keys, biology, distribution, fig. 178, Alberta); Corkum and Currie, 1987:207 (biology of immature stages); Pruess and Peterson, 1987:530 (biology, distribution, Nebraska); Crosskey 1988:466 (list, distribution); Duque, Muñoz de Hoyos and Rothfels, 1988:300 (citation).

FEMALE. General body color yellowish gray, to grayish brown, to grayish black, rather densely pruinose. Length: body, 1.8–3.3 (av 2.6) mm; wing, 2.2–2.6 (av 2.4) mm.

Head black. Frons broad, at vertex about ¼ wider than at narrowest point, slightly

←

Figs. 18–26. *Simulium griseum.* 18. Head of ♀. 19. Proximal end of ♀ cibarium showing armature. 20. Palpus of ♀. 21. Female sensory organ, enlarged. 22. Female thorax, dorsal view. 23. Hind, mid-, and fore legs of ♀. 24. Claw of ♀. 25. Male terminalia. 26. Female terminalia.

less than ½ width of head, and about as wide as long; moderately covered with decumbent, whitish to pale yellow pile. Clypeus concolorous with frons; slightly longer than wide; with relatively long, whitish to pale yellow pile. Occiput densely covered with long, whitish to pale yellow pile that in some lights appears golden; postocular setae pale. Scape and pedicel of antenna pale yellowish orange, basal ½ or less of first flagellomere often pale yellow, remainder of flagellum dark brown to black; pedicle and first flagellomere subequal in length; fine pubescence pale yellow. Mandible with about 31–39 serrations. Blade of maxilla with 26–28 retrorse teeth. Palpus dark brown to black, distal 2 segments slightly lighter than palpomere 3; with pale yellow setae admixed with some brownish setae; palpomere 5 about 2 times as long as palpomere 3, palpomeres 3 and 4 nearly equal in length. Sensory vesicle slightly more than ½ as long as its segment, proximally situated, its neck very short, arising mediodorsally and extended vertically, with an enlarged round mouth. Median proximal space of cibarium moderately deep, broadly U-shaped, with a small median notch and two short lobes each bearing about 7 or more relatively large, irregular denticles and with a series of setalike denticles that extends about half way up inner margins of each arm, median notch often with several faint denticlelike undulations; dorsolateral arm moderately long, rather broad, heavily sclerotized.

Thorax with lobes of prescutum and postpronotum pale grayish yellow, distinctly paler than scutum; covered with long, semi-erect to erect, pale yellow pile. Scutum in dried specimens varying from uniformly yellowish gray to black with a dense grayish pruinosity, to having a faint pale median stripe and with a bright pruinose spot at anterolateral corner of scutum medial to postpronotal lobe; in alcohol preserved specimens scutum with a black pattern as in Figure 22; median dark stripe narrow at anterior margin of scutum between bright yellowish spots, this stripe broadened posteriorly, extended to posterior declivity, hind margin slightly emarginate at middle; a broad lateral black stripe on each side extended from bright yellow spot anteriorly to anterolateral angle of scutellum; lateral margin of scutum and notopleural ridge yellow providing a border extended around lateral and hind margins of scutum. Scutum covered with moderately dense, short, recumbent, whitish to pale yellow pile that sometimes has a faint golden sheen, and which is longer along lateral margin and still longer posteromedially. Scutellum slightly paler than scutum, with a faint pruinosity; densely covered with long, semi erect to erect yellowish setae. Postnotum brownish black to black, with a faint pruinosity. Pleuron yellowish brown to brownish black anteriorly, becoming slightly more pale posteriorly; anepisternal membrane slightly more pale than rest of pleuron; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins yellowish. Base of costa and stem vein with pale yellow pile; fringe of calypter and anal lobe pale yellow. Stem of halter pale yellow, knob more whitish, with pale pile.

Legs: Foreleg entirely yellow, with yellow pile, except tarsus which is brown to black with both pale yellow and dark brown setae; tarsomeres only slight swollen. Midleg entirely yellow with yellow pile, except coxa with dark brown markings especially on posterior surface, and tips of tarsomeres 1 and 2, and sometimes 3 that are variously brown, sometimes tarsomere 3 entirely brown concolorous with apical 2 tarsomeres; tarsomeres with pale yellow setae on yellow areas and brown setae on dark areas. Hind coxa brown, sometimes mottled with yellow; femur and tibia largely

yellow except browned on apical ⅓ or less; basitarsus yellow, browned on apical ⅓ or less, 2nd tarsomere yellow on basal ½, including pedisulcus, rest of tarsomeres brown; hind basitarsus about 7.5 times as long as broad; hind leg with pale yellow setae and some brown setae usually on dark portions of tarsus, posterior margin of hind tibia and basitarsus with 1 to 4 longer bicolored setae; calcipala small; pedisulcus small but deep and conspicuous. Claw short, simple, evenly curved from base; base pale yellow, remainder black.

Abdomen grayish yellow to yellowish brownish, basal scale (tergite 1) pale yellow, sometimes faintly mottled with brown, with a fringe of long, pale yellow pile; tergites 2–6 sclerotized, matte brown, 3 and 4 slightly larger than other tergites, tergites 7–10 yellow to brownish yellow, subshining; abdomen sparsely covered with short, pale setae except for some scattered short, brown setae on pleural membrane especially on dark pleural markings; pleural membrane of segment 4 and usually of segment 5, and sometimes of segments 3 and 6, marked with an irregular, ventrally elongate, dark spot, that of segment 4 largest; sternites 1–7 weak, hardly discernible; sternite 8 heavily sclerotized, especially on posterior ½ which is dark brown and moderately covered with long, dark brown setae. Terminalia as in Figure 26. Anal lobe narrow dorsally, broadened ventrally, subrectangular below level of cercus, with posterior margin produced beneath cercus as a short, pale conical setose lobe, anteroventral margin tapered ventrally to a moderately long, slender, digitiform process that is ¼ longer than height of cercus; posteroventral marginal area rather densely setose, anteroventral area moderately heavily sclerotized, sparsely setose. Cercus subrectangular, about ¼ higher than long, hind margin strongly rounded, moderately setose. Hypogynial valve short, not reaching to anterior margin of cercus, subtruncate posteriorly, medial margin diverging from that of other side, faintly sclerotized, bare except lightly microsetose proximally. Stem of genital fork long, heavily sclerotized, about 2.3 times as long as arms; arm moderately long, posteromedial corner produced as a large medially directed, lightly sclerotized lobe with a blunt tip, anterior margin of arm with a heavily sclerotized ridge bearing a short, internal toothlike process; arm narrowly attached to segment 9. Spermatheca subglobular, heavily sclerotized, with a faint reticulate pattern.

MALE: General body color black, thorax densely grayish pruinose. Length: body, 2.1–3.2 (av 2.7) mm; wing, 1.6–2.0 (av 1.8) mm.

Frons, clypeus and occiput with long, erect, yellow pile. Antenna with scape, pedicel and basal half or less of first flagellomere yellow, remaining flagellomeres black; first flagellomere and pedicel nearly equal in length; fine pubescence pale yellow. Palpomere 3 black, palpomeres 4–5 paler yellowish brown, all with black pile; palpomere 5 2.2–2.5 times longer than palpomere 3. Sensory vesicle about ⅕ as long as its segment; neck hardly discernible, with a small round mouth.

Postpronotum varying from grayish yellow to black, with pale yellow pile. Scutum usually entirely black and densely grayish pruinose, in anterior view with a short, bright, silvery pruinose spot just medial and posterior to postpronotal lobe, this spot sometimes appearing black in rubbed or greasy specimens, and not or only faintly visible in posterior view; sometimes lateral margin and notopleuron paler brownish to yellowish; scutum covered with short, recumbent, pale yellow pile that is longer along anterior and lateral margins and even longer posteromedially. Scutellum varying from yellowish brown to brown, densely covered with long pale yellow setae.

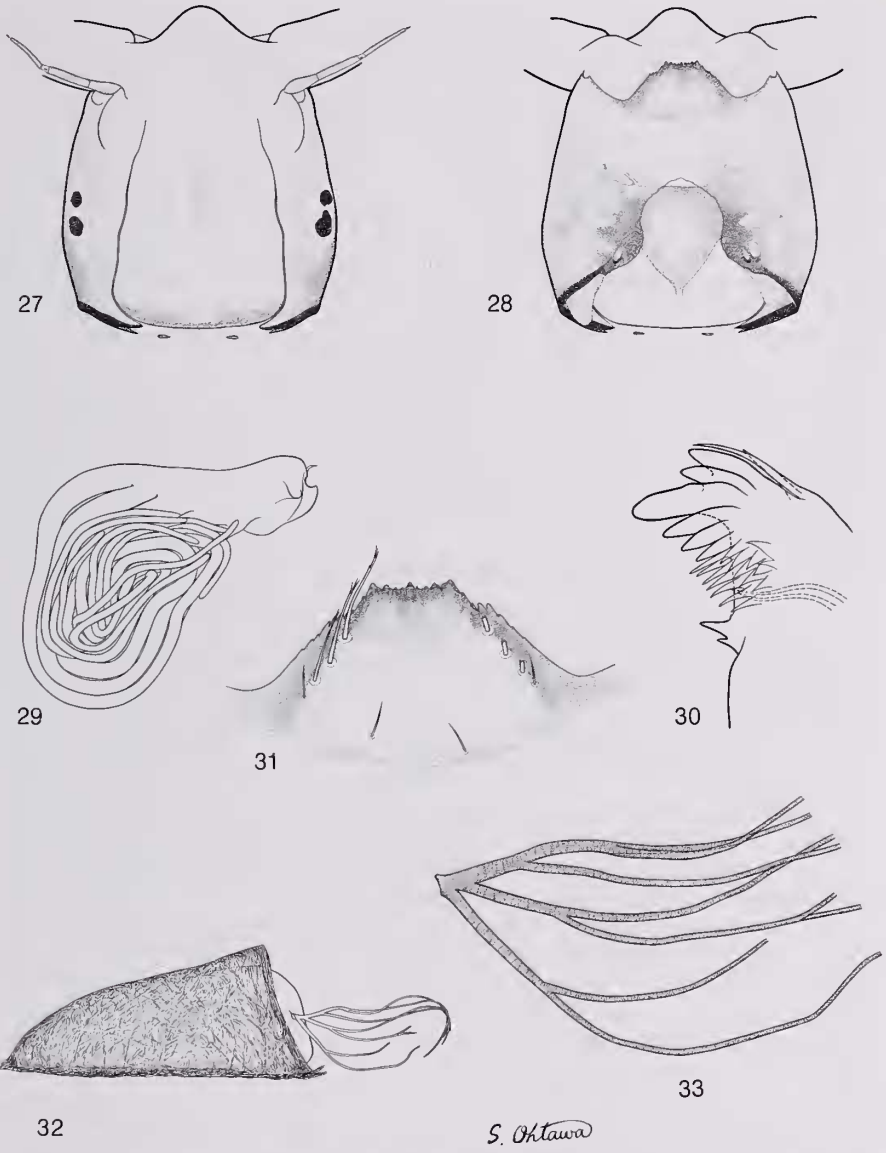
Postnotum usually concolorous with scutum but sometimes distinctly more brown, with a grayish pruinosity. Pleuron usually entirely black and densely grayish pruinose, sometimes mesepimeron slightly more brown and faintly mottled with yellowish; anepisternal membrane varying from yellow to black; mesepimeral tuft pale yellow.

Wing membrane hyaline; veins yellowish white; base of costa, stem vein and other veins with pale yellowish to whitish pile; fringe of calypter and anal lobe pale yellowish to whitish. Knob of of halter yellow, stem brownish at base, with pale yellowish pile.

Foreleg yellow except for tarsus which is black; with mostly yellow pile except black setae predominant on tarsomeres. Midleg yellow except for coxa and distal 2 or 3 tarsomeres which are black, 3rd tarsomere varying from having basal half yellow to all black; with mostly yellow setae except for black setae on dark areas. Hind leg yellow except coxa, usually distal ⅓ or less of femur, distal ⅓–½ of tibia, apical ¼ of basitarsus and basal ½ or slightly more of 2nd tarsomere which are black; femur sometimes showing considerable variation from being all yellow to all black, sometimes 3rd tarsomere with basal half yellow and sometimes all black; setae mostly yellow except for some black setae on dark portions of leg; hind basitarsus slender, varying from 5 to 8 times as long as broad, Calcipala short, not reaching pedisulcus; pedisulcus deep and relatively long.

Abdomen showing considerable variation in color with pinned specimens being mostly black while alcohol preserved specimens show more yellow especially laterally and ventrally; basal scale with dorsomedial portion yellow and lateral portions black, always with a fringe of long, pale yellowish to whitish pile; tergite 2, in alcohol preserved specimens, entirely yellow or with a small, black, central marking, in dried specimens this tergite densely grayish pruinose and strongly contrasting with following tergite; tergites 3–5 and 7 largely black; tergite 6 in alcohol preserved specimens yellow except for narrow, black, anterior margin, in dried specimens this tergite densely grayish pruinose strongly contrasting with preceding tergite; terminal tergites black, except lateral portions of 7 and extreme lateral margins of 8 densely grayish pruinose; sparsley covered with short, yellow pile which is longer laterally and on pleural membrane; tergite 10 small, subquadrate, about as long as broad, hind margin usually rounded; sternites pale yellow, sometimes tinged with varying amounts of black, with mostly pale yellow setae.

Terminalia as in Figure 26. Gonocoxite rectangular but tapering distally, about ⅓ longer than greatest width, sparsely setose on distal ½. Gonostylus short, rectangular, about twice as long as greatest width at base; broadly rounded on outside distal corner, slightly concave medially, and inner distal corner produced as a short, but prominent, triangular process bearing a single apical spine, this process somewhat accentuated by slight concavity of medial margin of gonostylus. Ventral plate of aedeagus broad, flattened, widest distal to junction with basal arms, greatest width slightly more than greatest length, distal margin broadly rounded, slightly peaked medially, proximal margin between basal arms arcuate, basal arm very short, pointed; in lateral view, with a short ventral lip, ventral face of which is concave; ventral surface densely covered with short setae. Median sclerite of aedeagus relatively broad, heavily sclerotized, tapered distally; arms short, imperfectly separated, distal margin of each arm obliquely rounded with a narrow sclerotized rim that forms a prominent, lateral process that extends outwardly beyond stem. Aedeagal membrane densely covered with a series of minute, irregular, comblike thickenings bearing minute



Figs. 27–33. *Simulium griseum*. 27. Head capsule of larva, dorsal view. 28. Head capsule of larva, ventral view. 29. Respiratory histoblast of mature larva. 30. Tip of mandible of larva. 31. Hypostoma of larva. 32. Cocoon and pupa, lateral view. 33. Basal portion of respiratory organ of pupa.

setulae. Plate of endoparameral organ subquadrate to somewhat conical, slightly tapered distally, with 1 strong and several weaker, ridgelike thickenings, arm bent medially at about a right-angle and then shortly bent posteriorly, bearing about 6–8 relatively well defined, moderately large, basal teeth plus about 8–12 smaller, weaker and ill defined teeth; parameral arms running subparallel posteromedially, tips of arms approaching each other distomedially.

PUPA. Length 2.5–3.4 (av 2.9) mm. Respiratory organ (Fig. 33) 1.8–2.3 (av 2.0) mm, shorter than pupa; consisting of a short, rather slender base covered with minute spicules, and with 8 filaments arranged in 2 main groups: a ventral group with 2 filaments, and a dorsal group that branches into 2 groups of 3 filaments each that branch (2+1) + (1+2) (dorsal, ventral); petiole of ventral pair of filaments slightly longer than subequal petioles of mediolateral and dorsal groups of filaments. Filaments yellowish to gray, slender, with narrow but distinct annulations. Integument of head and thorax with numerous distinctly raised granules resembling sandpaper; antennal sheath of male reaching only about ½ distance to hind margin of head; antennal sheath of female short of reaching hind margin of head by about length of 1 antennomere; clypeus with a submedian pair of pale setae just below level of base of antenna. Thorax laterally with 3–6, slender, pale trichomes that are simple or bifurcate, these sometimes difficult to see; a row of 5–6 tiny setae present just anterior to wing and metathoracic leg sheaths and with a single, larger, more anterior seta. Chaetotaxy of each lateral half of abdominal tergites as follows: tergite 1 with 1–3 pale setae laterally; tergite 2 with 4 short, hooklike setae along posterior margin and with 2–3 tiny, more anterior setae; tergites 3 and 4 each with 4 anteriorly directed hooks along posterior margin and 4–5 scattered setae anterior and lateral to hooks; tergite 5 and usually 6 bare; tergites 8–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, these occasionally present on tergites 6–7 but vary from 4–5 spines to (more rarely) a nearly complete row of spines but these are always weakly developed; caudal spines very short, situated on two faintly swollen convexities, straight, tips subparallel to slightly convergent. Chaetotaxy of each lateral ½ of sternites as follows: sternite 3 bare; sternite 4 with 1 small, submedian, slender hook; sternites 5–7 each with 2 longer, rather slender hooks, those of 5 submedian and closer together, those of 6–7 more widely separated but lateralmost hooks not lying in pleural membrane; sternites 8–9 bare. Cocoon slipper-shaped, yellowish to grayish, densely woven, anterior margin narrowly but noticeably thickened; in lateral view, anterolateral margin of cocoon slightly concave but distinctly sloping forward so that about ⅕ of total length extends in front of dorsal rim; floor of cocoon extends forward about ½ length of cocoon.

LARVA. Length 3.7–4.2 (av 4.0) mm. Body color pale yellowish white to brownish yellow; often abdominal segments dorsally each with a sublateral gray spot on each side leaving a longitudinal white median stripe extended along first 5 or 6 segments, posterior segments sometimes continuously gray across segment, ventrally abdomen more pale except for gray nerve cord; intersegmental lines rather broad, often slightly lighter than rest of abdomen. Head capsule (Figs. 27, 28) essentially as in *bivittatum* with a similar head spot pattern except specimens available for study are distinctly paler and pattern more obscure than in *bivittatum*. Antenna nearly transparent, faintly yellowish; distinctly longer than stalk of labral fan; proportions of antennomeres (basal to apical) 11:13:13. Labral fan with about 30–36 primary rays. Hypostoma as

in Figure 31; distal margin of hypostoma nearly straight to slightly concave, median tooth usually faintly longer than outer lateral teeth, sublateral teeth all small and subequal in size, paralateral teeth and lateral serrations faintly indicated; with 3 longer and 1 shorter hypostomal setae on each side and 1 pair of posterior sublateral setae. Hypostomal cleft moderately deep, extended about ⅔ distance to base of hypostoma, broadly rounded distally, about as wide as long. Hypostomal bridge subequal in length to hypostoma. Mandible with 4–5 apical teeth of varying sizes and a toothlike process set at about 90° to base of apical teeth, this process appearing shorter, broader and less sclerotized than that in *bivittatum*; with about 6 comb teeth; inner subapical ridge with 2 fine serrations, distalmost larger, proximal serration much smaller and often difficult to see. Maxillary palpus nearly parallel sided, about 3.5 times as long as width at base. Lateral plate of proleg broad, subquadrate, lightly sclerotized, extended about ¾ or more length of apical segment; circlet of apical hooks arranged in 20–28 rows. Anal setulae very small and difficult to discern, sparsely scattered laterally between arms of anal sclerite and between this sclerite and posterior circlet of hooks; anal papillae composed of 3 simple lobes, outer lobes arising next to base of median lobe and diverging laterally; abdomen with 2 small but noticeable ventral tubercles. Arms of anal sclerite broadly joined medially and often with a short, sclerotized lobelike projection anteriorly between anterodorsal arms; anterodorsal arm moderately broad, rather heavily sclerotized but not as strongly as posteroventral arm, about ⅓ shorter than posteroventral arm which is slender and heavily sclerotized. Posterior circlet of hooks consisting of about 11 hooks in about 60 rows.

REMARKS: Coquillett (1898) named *Simulium griseum* with no description other than that given in a key to the species of the United States. He separated the females out at couplet 8 of his key (based on three specimens), and mentioned they were from Colorado, but he made no mention of the male at this point. In couplet 10 of his key he separated out the male, and indicated that it was taken with the females mentioned above. Coquillett did not designate a holotype, but the single male in the collection bears a type label presumably placed there by Coquillett. The head, thorax, legs and wings of the holotype are glued to a paper point and pin mounted. The uppermost label on the pin is smaller than the lower labels and bears the data, "Colo. 1605." The next lower label is a red type label with "Type No. 10381 U.S.N.M." Below this is a yellow label with "Pseudotype," followed by a label with "slide" on it, and finally the bottom label carries the name "*Simulium griseum* Coq." The head of the type is shriveled, but complete; the scutum is spotted with grease marks but the anterior sublateral, pruinose, triangular patches are distinct and the remainder of the scutum clearly shows the overall extent of the pruinosity, demonstrating that it is not *bivittatum* or any of the other species treated here. The legs are complete, as is the left wing, but the right wing consists only of a narrow strip with the anterior veins, and the extreme base of the blade of the wing, the rest is missing. The abdomen of the type is mounted on a slide under a single coverslip. The slide is labeled "*Simulium griseum* Coq.," and in the same ink and handwriting, "Type ♂." No other data appear on the slide label. All parts of the terminalia are visible but quite flattened.

Although *griseum* is a relatively widespread species, often overlapping or even sharing the same habitats with *bivittatum,* it was not found in as large numbers as the latter species. I suspect that this species has been misidentified on numerous occasions, especially material preserved in alcohol. In dry, pinned females the dorsum

of the scutum is rather uniformly brownish gray, often with a tinge of yellowish or even greenish pruinosity, and without strong evidence of thoracic vittae. However, in fluid preserved specimens the scutum often shows strong dark marks, especially laterally and medially, with the median stripe usually shorter than lateral stripes, and rounded posteriorly. In this respect, it sometimes approaches *venator* and even *mediovittatum,* in thoracic similarity of fluid preserved specimens. The males of *griseum,* even those in alcohol, are more uniformly dark, with a marked grayish pruinosity on the scutum, while the scutum of *bivittatum* is much more matte black without the grayish pruinosity, and the lateral margins and notopleuron are usually tinged with distinct patches of yellow. From an anterodorsal view, the male scutum of *griseum* shows two sublateral, triangular spots anteriorly that are much smaller than those of *bivittatum.* This feature is usually evident in both dry and alcohol preserved material. However, at times, specimens show up that defy identification even using genital characters.

Also, see notes under *bivittatum* regarding the separation of these two species in the pupal stage.

SPECIMENS EXAMINED (total—998 males; 991 females; 108 pupae and pupal pelts; 379 larvae): ALBERTA (Canada): One Tree Creek, Brooks, August 6, 1958, F. J. H. Fredeen, (P, L). ARIZONA: *Coconino Co.,* May 26–October 6, (A). *Gila Co.,* August 22, (A). *Maricopa Co.,* April 9, (A). *Pinal Co.,* May 11, (A). *Santa Cruz Co.,* March 10, (A). *Yuma Co.,* April 6–8, (A). CALIFORNIA: *Imperial Co.,* April 7–June 11, (A). *Monterey Co.,* March 25, (A). *Riverside Co.,* April 30–June 12, (A). *San Bernardino Co.,* April 28–December 13, (A). *Tulare Co.,* June 9–July 1, (A). COLORADO: Colorado (no other data) (includes syntypes). *Adams Co.,* August 1, (A). *Boulder Co.,* no date, (A). *Crowley Co.,* August 14–20, (A). *La Plata Co.,* July 17, (A). *Larimer Co.,* June 2–September 19, (A). *Mesa Co.,* July 29–October 8, (A). *Pueblo Co.,* July 25, (A). *Weld Co.,* March 21–October 15, (A). NEBRASKA: *Lincoln Co.,* August 23, (A). *Scotts Bluff Co.,* September 8, (P, L). NEW MEXICO: *Bernalillo Co.,* April 30–August 2, (A). *Catron Co.,* October 20, (A). *Doña Ana Co.,* April 16–September 2, (A, P, L). *Grant Co.,* June 24–October 21, (A, L). *Guadalupe Co.,* June 7, (A, L). *Mora Co.,* August 17, (A). *Socorro Co.,* August 7, (A, P, L). *Taos Co.,* July 6, (A). NEVADA: *Clark Co.,* December 16, (A). SOUTH DAKOTA: *Fall River Co.,* Hot Springs, July 9–30 (A). UTAH: *Grand Co.,* August 21, (A). *Salt Lake Co.,* July 29–August 1, (A). *San Juan Co.,* August 30, (A). *Sevier Co.,* June 15, (A). *Wasatch Co.,* July 21, (A). *Washington Co.,* March 17–September 9, (A, P, L). *Wayne Co.,* May 18, (A). WYOMING: *Carbon Co.,* June 22, (A). *Converse Co.,* 1986, (A). *Platte Co.,* 1986, (A). *Sweetwater Co.,* July 13–17, (A). *Washakie Co.,* July 20, (A).

PREVIOUS RECORDS: CANADA: Alberta, Saskatchewan. U.S.: California, Colorado, Montana, Nebraska, New Mexico, Texas, Utah.

BIOLOGICAL NOTES: This small, multivoltine species is often collected in combination with *S. bivittatum,* and has essentially the same seasonal and geographic distribution. However, it does not seem to be nearly as abundant as *S. bivittatum* in the northern reaches of their ranges. Because the immature stages of the two species are so similar, it has been difficult for authors to be sure of the species with which they were dealing. *Simulium griseum* frequently accompanied *S. bivittatum* in the light trap collections mentioned in the discussion under the latter species, and nearly always was present in fewer numbers of both sexes. This species also is a pest of

horses (MacNay, 1958a, 1959a, c, d; Jones et al., 1977), and to a lesser extent cattle and man (MacNay, 1952, 1961a, b, c; Fredeen, 1958; Fredeen and Shemanchuk, 1960; Fredeen, 1973). There are specimens in the USNM collection labeled as taken from horses and steers. Ryckman (1961) observed that the ears of the jackrabbit, *Lepus californicus* Gray, were heavily bitten by *Simulium griseum* (and two species of Ceratopogonidae), during daylight hours in Imperial County, California. In the more northern reaches of the range of this species, it overwinters in the egg stage, while in the more southern parts of its range larvae can be found, in varying numbers, throughout most of the year. The immature stages often occur in greatest abundance in the warmer, slower flowing waters of small irrigation ditches. Edmunds (1954) reported it to occur in large numbers on cement drop structures of irrigation systems in Nebraska. Miscellaneous biological notes on this species can be found in the papers by Fredeen (1964, 1977), Depner (1971), and Currie (1986).

Simulium (*Psilopelmia*) *mediovittatum* Knab
Figs. 34–50, 126–132

Simulium mediovittatum Knab, 1915b:77 (♀, original description); holotype ♀, Type #19635 (USNM). Dyar and Shannon, 1927:37 (♀, description, key, distribution); Stains and Knowlton, 1943:279 (♂, ♀, key, distribution, figs. 85–86, 117, 127, 129); Smart, 1945:508 (catalog [as *meddiovittatum*], distribution); Vargas, 1945c:159 (catalog, synonymy, distribution [one entry as *madiovittatum*]); Knowlton and Fronk, 1950:5 (Utah); Vargas and Díaz Nájera, 1954:69 (♀, pupa, larva, description, figs. 31–39, first record in Mexico); Peterson, 1955:114 (Utah); Peterson, 1959: 151 (citation); Wiseman and Eads, 1960:45 (biting, distribution in Texas); Vulcano, 1967:16 (catalog, distribution); Field, 1969:284 (compared with *fuliginis* Field); Travis, Lee and Labadan, 1969:131 (citation); Newell, 1970:47 (Montana); Tipton and Saunders, 1971:11 (Utah); Travis, Vargas V. and Swartzwelder, 1974:190 (biting humans in Neotropical Region); Jones et al., 1977:443 (attacking horses).

Simulium (*Neosimulium*) *mediovittatum,* Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

Simulium (*Lanea*) *mediovittatum,* Vargas, Martínez Palacios and Díaz Nájera, 1946: 107 (citation).

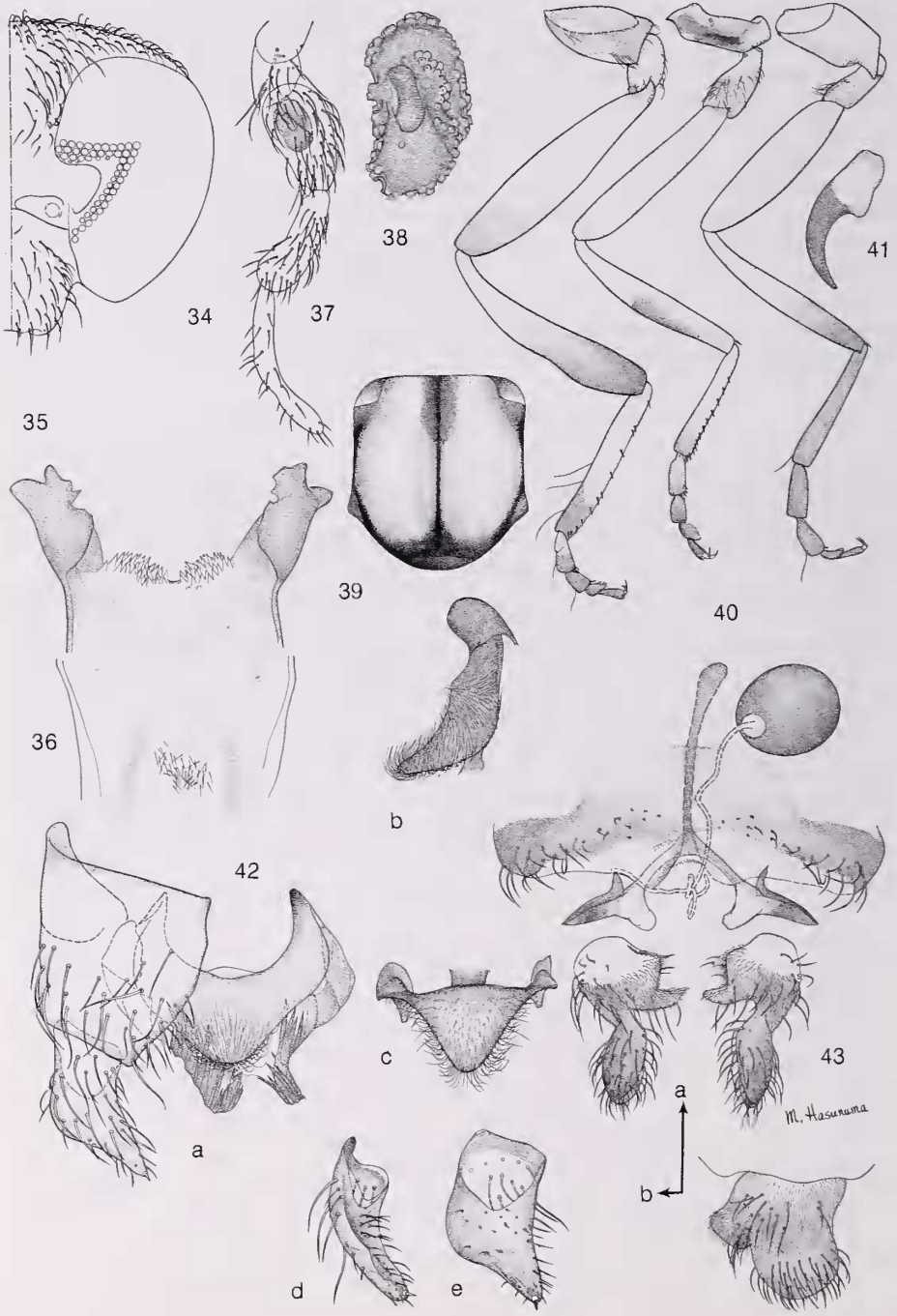
Simulium (*Psilopelmia*) *mediovittatum,* Vargas and Díaz Nájera, 1957:154 (♂, ♀, pupa, keys, figs. 343–349, distribution in Mexico); Vargas and Díaz Nájera, 1958:14 (♂, ♀, pupa, keys, Mexico); Peterson, 1960b:100 (♂, ♀, pupa, keys, type, type locality, distribution); Díaz Nájera and Vulcano, 1961:221 (citation); Stone, 1965:187 (catalog, distribution); Coscarón, 1987:31 (list distribution); Crosskey, 1988:466 (list, distribution). Crosskey and Lowry, 1990:220 (paratype in BM(NH)).

Simulium (*Neosimulium*) *venator,* Vargas, 1945c:159 (listed as synonym of *mediovittatum*); nec Dyar and Shannon, 1927; Rubtsov, 1940.

Simulium venator, Stains and Knowlton, 1943:279 (syn. of *mediovittatum*); Smart, 1945:508 (syn. of *meddiovittatum* [sic]); Vargas, 1945c:159 (syn. of *mediovittatum*); nec Dyar and Shannon, 1927.

Simulium (*Simulium*) *venator,* Vargas, 1945c:159 (syn. of *mediovittatum*); nec Dyar and Shannon, 1927; Twinn, 1938.

FEMALE. General body color somewhat variable but usually brownish black with


34
35
36
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39
40
41
42
a
b
c
d
e
43
a
b
M. Hasegawa

a distinct underlying orange tinge. Length: body, 1.8–2.9 (av 2.5) mm; wing, 1.9–2.4 (av 2.2) mm.

Head brownish black to black, densely grayish pruinose. Frons broad, at vertex about ⅔ as wide as at narrowest point, slightly less than ½ width of head, width and length subequal; moderately covered with moderately long, whitish to pale yellow pile. Clypeus concolorous with frons; slightly longer than wide; moderately covered with moderately long, pale yellow pile. Occiput densely covered with long, pale yellow pile; postocular setae pale. Antenna with scape, pedicel and basal ½ of first flagellomere yellow to orange, flagellum varying from entirely yellow, to orange and often tinged with brown, to brownish black; pedicle and first flagellomere subequal in length; fine pubescence pale yellow. Mandible with about 29–39 serrations, those of outer margin weak and varying in number from 4–12. Blade of maxilla with 23–28 retrorse teeth. Palpus brown to black, often with an underlying yellowish or orange tinge, and pale yellow setae; distal 2 segments often slightly lighter than palpomere 3; palpomere 5 about ⅓ longer than palpomere 3, palpomere 4 slightly longer than 3. Sensory vesicle slightly more than ½ as long as its segment, proximally situated, its neck short but distinct, arising middorsally and extended vertically, with an enlarged ovoid mouth. Median proximal space of cibarium shallow, broadly U-shaped, with 2 low lobes and a relatively broad median depression, lobes each bearing a series of fine, but variably distinct, setalike denticles that extend nearly to middle of median depression; dorsolateral arm shorter than in other related species, broad, heavily sclerotized.

Thorax rather variable in color ranging from yellowish orange to brownish black to black but with at least traces of an underlying orange tinge, and extensively gray pruinose. Antepronotum and postpronotum distinctly paler than scutum; covered with long, semi-erect to erect, pale yellow pile. Scutum showing considerable variation in colors noted above, and often a mottled combination of these colors, densely grayish pruinose except longitudinally along midline; anterolateral corner of scutum without a distinct white or grayish spot, but with a single median, moderately broad, distinct, non-pruinose stripe that varies from orange through brown to black, and extends from anterior margin of scutum to posterior declivity; lateral margin of scutum and notopleural ridge paler than dorsum; scutum sparsely covered with short, recumbent, pale yellow pile that is longer along lateral margin and posteromedially. Scutellum usually concolorous with basic dark color of scutum, but sometimes paler yellowish brown, orange brown, blackish brown or black; densely covered with long, pale yellow and a few brownish setae. Postnotum brownish black, with a dense grayish pruinosity. Pleuron yellowish to orange brown to brownish black and densely gray pruinose anteriorly, and sometimes mottled medially and posteriorly; anepisternal membrane concolorous with rest of pleuron, at most faintly paler; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins yellowish. Base of costa and stem vein with pale

←

Figs. 34–43. *Simulium mediovittatum.* 34. Head of ♀. 35. Proximal end of ♀ cibarium showing armature. 36. Central portion of cibarium showing patch of microsetae. 37. Palpus of ♀. 38. Female sensory organ, enlarged. 39. Female thorax, dorsal view. 40. Hind, mid-, and fore legs of ♀. 41. Claw of ♀. 42. Male terminalia. 43. Female terminalia.

yellow pile; fringe of calypter and anal lobe pale yellow. Halter whitish to pale yellow, with pale setae.

Legs: Forecoxa yellow, faintly tinged with brownish; femur yellow but with varying portions brown; tibia yellow; tarsus dark brown, tarsomeres only slightly swollen. Midleg with coxa brown; femur, tibia and basal 4 tarsomeres yellow but femur and tibia variably ringed with brown dorsally on apical ½, basal 4 tarsomeres variably tinged with brown but apical tarsomere entirely brown. Hind coxa brown; femur varying from all yellow variably marked with brown on dorsal surface to entirely brown; tibia yellow on about basal ½, remainder dark brown; basitarsus yellow but brown on about apical ¼; basal ½ of both second and third tarsomeres yellow, remainder brown; distal 2 tarsomeres brown; hind basitarsus about 7 times as long as broad; calcipala small but conspicuous; pedisulcus small but deep and conspicuous. Pile on legs mostly pale yellow with some scattered dark setae near apices of tibiae and on tarsi and some scattered brownish setae elsewhere on darkened portions of legs, long setae on posterior margins of tibiae and tarsi mixed pale and dark. Claw short and simple, evenly curved from base.

Abdomen yellowish gray to brownish black, basal scale (tergite 1) paler yellowish gray to yellowish brown, with a fringe of long pale yellow pile; tergites 2–6 matte brown, tergites 7–10 paler yellowish gray to yellowish brown; pleural membrane of segments 3–6 with elongate, ventrally directed, dark markings, that of segment 6 sometimes reduced; sternites 1–7 hardly discernible, sternite 8 heavily sclerotized, dark brown and with pale setae along posterior margin; abdomen mostly with short, pale yellow setae but with some scattered, short, brown setae on dark markings of pleural membrane, and posterior segments with a few longer dark setae.

Terminalia as in Figure 43. Anal lobe short, moderately setose; in lateral view, vaguely <-shaped, with each arm subequal in length and about as broad dorsally as ventrally, ventral arm noticeably more sclerotized than dorsal arm and in one view shows a short ventral convexity or lobelike process but without a conspicuous digitiform process; shortly produced posteriorly beneath cercus with posteroventral margin rather truncate and fringed with short, fine setae; in ventral view, anteroventral (inner distal) corner produced as a slight but distinct convexity or lobe, and posteroventral (inner proximal) corner acutely rounded. Cercus subquadrate, slightly higher than long, hind margin broadly rounded, moderately setose. Hypogynial valve nearly transparent and difficult to see except under high magnification; short, subtriangular, rather broadly rounded to slightly pointed posteromedially, with medial margin lightly sclerotized, rather straight or faintly concave; valves narrowly separated basally, divergent distally, sparsely microsetose on basal ¼ or less. Stem of genital fork heavily sclerotized, rather long, about twice as long as arms, and rather sinuous to strongly curved; in lateral view, rather strongly bent ventrally from point of origin of arms; arms moderately broad, divergent but space between them broadly rounded, inner posterior corner of arm rounded to broadly but shortly pointed, hind margin broadly but shallowly concave with anteroventral margin produced rimlike and posterodorsal (inner) margin with a sclerotized, toothlike process directed anteriorly and extended from point of origin about ½ total length of arm; arm narrowly attached to segment 9. Spermatheca small, rounded, heavily sclerotized, apparently without a pattern, but with a small, round, membranous area at junction with spermathecal duct.

MALE. General body color black. Length: body, 1.92–3.0 (av 2.5) mm; wing, 1.6–2.0 (av 1.8) mm.

Medial marginal area between eyes, upper margin of frons, and clypeus with erect brownish yellow pile. Occiput with long, yellow and brownish yellow setae. Antenna dull yellow with a faint brownish tinge; first flagellomere and pedicel equal in length; fine pubescence pale yellow. Palpus brown, palpomere 3 slightly darker, with brownish yellow setae; palpomere 5 about twice as long as palpomere 3. Sensory vesicle small, about ⅛ to ¼ as long as its segment; neck very short, with a small round mouth.

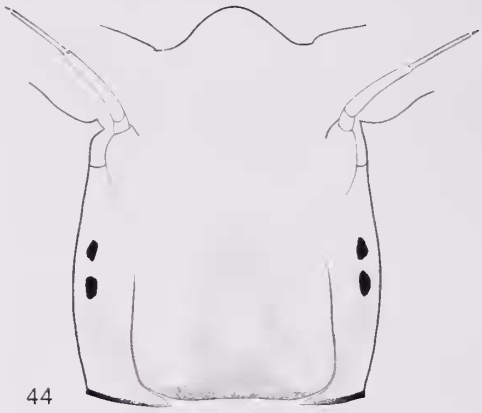
Prescutum pale brown; postpronotum slightly darker, and grayish pruinose; with pale yellow pile. Nonpruinose areas of scutum matte black, lateral margins and posterior declivity bright grayish to silvery pruinose; in anterior view, with a large, bright, grayish to silvery pruinose triangular mark just medial and posterior to postpronotal lobe, this mark strongly tapered medially along outside margin to a level just in front of base of wing and continues posteriorly as a slender stripe that unites with pruinosity of posterior declivity; covered with long, recumbent, pale yellow pile along anterior and lateral margins, and short, pale yellow setae on pruinose areas and coppery brown setae on black areas of scutum. Scutellum brown to black but paler than scutum; densely covered with long, pale yellow setae some of which may have dark bases. Postnotum concolorous with scutellum, lightly pruinose. Pleuron, including anepisternal membrane, nearly uniformly dark brown to black and densely grayish pruinose; mespimeral tuft small, of short, brownish yellow setae.

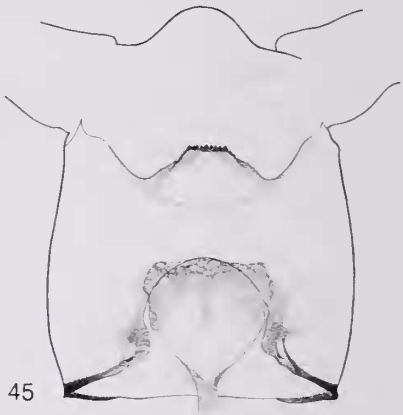
Wing membrane hyaline; veins whitish to faintly yellowish; base of costa, and stem vein with pale yellow setae some of which may have dark bases; fringe of calypter and anal lobe pale yellow. Knob of halter white, stem brown, with brownish yellow setae.

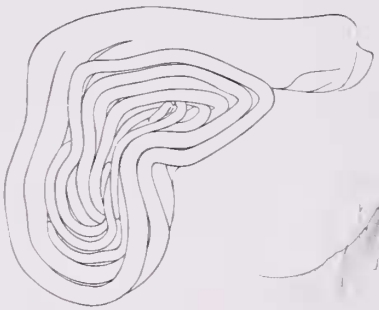
Foreleg mostly yellow except for coxa which is variously blackened, femur which is variously but lightly tinged with black, most of dorsal ½ of tibia and all tarsomeres black. Midleg largely yellow except coxa, apical ⅓ to ½ of femur and tibia, and apical ¼ of basitarsus which are variously tinged with black, and tarsus which is all black. Hind leg largely black except for about basal ⅓ of femur, basal ½ of tibia, ½ to ⅔ of basitarsus, and basal ½ of second tarsomere which are yellow; hind basitarsus slender, 5 to 6 times as long as broad; calcipala short, just reaching pedisulcus, rounded; pedisulcus small but moderately deep; legs with mostly yellow setae on yellow portions and mostly black setae on black portions.

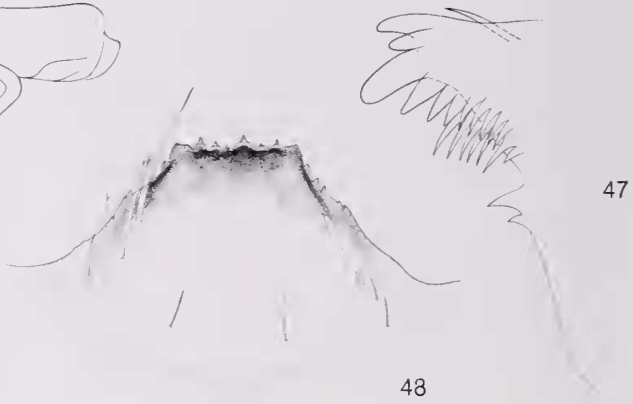
Nonpruinose areas of abdominal tergites matte black; basal scale tinged with yellow, bearing a fringe of long yellow pile; tergites 2, 5, 7 and 8 each with a central black spot and densely grayish pruinose laterally; tergites 4 and 5 without pruinosity; tergite 6 entirely pruinose; tergites dorsally with short setae that appear pale yellow in some views and coppery brown in other views, laterally all tergites with long, pale yellow setae; tergite 10 small, rectangular, about 2.5 times as long as broad; pleural membrane gray, densely pruinose; sternites yellowish, densely pruinose, with mostly pale yellow setae.

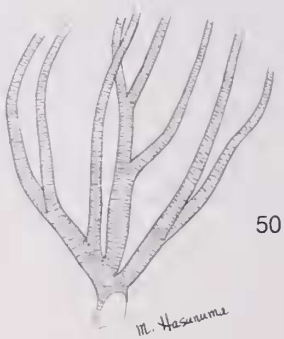
Terminalia as in Figure 42. Gonocoxite subrectangular, length and width nearly equal, tapered distally, sparsely covered with setae on about distal ½, about ¼ longer than gonostylus. Gonostylus angularly subrectangular, greatest length about twice width at base; outer distal corner broadly rounded, obliquely continuous with inner











Figs. 44–50. *Simulium mediovittatum*. 44. Head capsule of larva, dorsal view. 45. Head capsule of larva, ventral view. 46. Respiratory histoblast of mature larva. 47. Tip of mandible of larva. 48. Hypstoma of larva. 49. Cocoon and pupa, lateral view. 50. Basal portion of respiratory organ of pupa.

distal corner that is produced as a relatively long, triangular projection bearing a single terminal spine, this process considerably longer than in any of the other species treated in this work. Ventral plate of aedeagus, in ventral view, triangular, broadest just distal to junction of body and basal arms, lateral margins broadly rounded or sometimes lateral margins slightly concave near tip but tapered distally to a median point, proximal margin between basal arms usually strongly convex at middle but sometimes weakly concave, basal arm broad at junction with body but slightly curved inwardly and tapered distally to acute point, strongly sclerotized; in lateral view, with a short, but prominent, ventral lip; dorsal and ventral surfaces densely covered with moderately long setae; median sclerite of aedeagus with stem only slightly longer than arms, sclerotized, slender basally, widening distally; arms paler and poorly defined, expanded clublike, distal margin sclerotized but less so around gonopore; aedeagal membrane densely covered with closely placed comblike clumps of minute setulae. Basal plate of endoparameral organ slender, rectangular, with a series of ridgelike, cuticular thickenings; arm slender with 2–4 (usually 2) strong, well defined spines near base that are continuous with a distal cluster of 15 or more (about 15–24 but difficult to count) smaller, closely placed and less well defined spines among which may be 2–4 better defined spines that approach basal spines in size and development.

PUPA. Length 2.2–3.6 (av 2.6) mm. Respiratory organ (Fig. 50) 1.4–1.9 (av 1.6) mm, usually broken but apparently distinctly shorter than pupa; consisting of a short, rather slender base covered with minute spicules, and with 8 filaments arising in 3 groups branching (2+1) + (2+1) + (2) (d-v); dorsal group on a short petiole, mediolateral and ventral groups on longer, subequal petioles; in lateral view, filaments usually spread out so no branch obscures any other branch; filaments grayish to yellowish, rather smooth with only faint indications of fine, closely placed annulations. Integument of head and thorax moderately covered with slightly raised, rounded granules of rather uniform size; clypeus with a pair of submedian setae just anteroventral to bases of antennae, and with 2 setae along edge of frons just above base of antenna; antennal sheath of male reaching about ½ distance to hind margin of head; antennal sheath of female short of reaching hind margin of head by about length of 2 distal antennomeres. Thorax with 4–9 dorsal trichomes on each side most of which are long, slender and pale, and simple or bifurcate, and with a single seta just anterior to base of metathoracic leg sheath, and another near base of wing sheath. Chaetotaxy of each lateral half of tergites as follows: tergite 1 with 2 short lateral setae; tergite 2 with 4 short hooklike setae and 2 more lateral setae; tergites 3 and 4 with 4 stout, anteriorly directed spines along posterior margin and with a single seta just anterior and another just lateral to lateralmost hook and a similar seta just medial to innermost hook; tergites 5–7 largely bare, except tergite 6 laterally with a small patch of very minute spinules, and tergite 7 with 3 or 4 slightly larger, posteriorly directed spinules laterally that merge with a patch of very minute spinules; tergites 8–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, those of tergite 8 with only a few minute lateral spinules, while those of tergite 9 merge laterally with a larger patch of minute spinules; caudal spines short and straight, each situated on a slightly swollen convexity, tips slightly divergent. Chaetotaxy of each lateral half of sternites as follows: sternite 3 with 2 very small, submedian setae, and an irregular band (consisting of a number of rows) of very minute spinules traversing entire width of sternite; sternite 4 with 2 small, slender, lateral setalike

hooks and a band of very minute spinules placed in about 8 or more rows, this band enlarged patchlike laterally; sternite 5 with 2 closely placed submedian hooks and a small, lateral patch of minute spinules and 1 longer seta; sternites 6–7 each with 2 widely separated hooks, lateral hooks not lying in pleural membrane, and each sternite with a small patch of minute spinules just anterolateral to ventralmost hooks; sternite 8 with a transverse band of very minute spinules in about 5 or more rows; sternite 9 bare. Cocoon slipper-shaped, brownish yellow, tightly woven but sometimes it is thin and transparent and appears delicate, anterior margin thickened dorsally but sometimes thinning somewhat ventrally; in lateral view, with a low profile, anterolateral margin projected in front of dorsal margin by about ⅛ of total length; floor loosely woven, extended anteriorly about half length of cocoon.

LARVA. Length 3.9–5.8 (av 4.5) mm. Body color light brownish yellow, slightly darker posterodorsally, intersegmental lines narrow, only faintly paler than remainder of abdomen. Head capsule (Figs. 44, 45) pale yellow to pale brownish yellow, head spots usually obscure and difficult to discern; anteromedian spot small, posteromedian spot larger, both pale yellow, anteromedian spot sometimes partially surrounded while posteromedian spot is entirely surrounded by a slightly darker, narrow, brownish area, frontoclypeal apotome anterior to head spots varying from pale yellow to transparent whitish color; eye spots small. Antenna slightly but distinctly longer than stalk of labral fan; basal 2 antennomeres nearly colorless, third antennomere faintly brownish, basal antennomere about ⅔ or slightly more, as long as other 2 antennomeres which are subequal in length, proportions of segments (basal to apical) 13: 15:16. Labral fan with 50–60 (av 55) primary rays. Hypostoma as in Figure 48; anterior margin of hypostoma nearly straight, median, sublateral and outer lateral teeth all heavily sclerotized and nearly equal in size, 2 paralateral teeth slightly smaller and less sclerotized, lateral serrations distinct but small and weak; with 2 long anterolateral, 2 shorter posterolateral, and 1 pair of short, sublateral hypostomal setae along posterior margin. Hypostomal cleft broadly rounded, distal margin faint and rounded to slightly pointed medially, distinctly longer than wide; cleft moderately deep, extended about ⅔ distance to base of hypostoma. Hypostomal bridge slightly shorter than hypostoma. Mandible with 6 apical teeth, about 8 combteeth, and inner subapical ridge with 2 fine serrations of which distalmost is largest, proximalmost somewhat variable in size but always smaller than distalmost serration. Maxillary palpus nearly parallel sided, tapered only slightly, about 3 times as long as width at base. Proleg with about 26–30 apical rows of hooklets; lateral plate of proleg broad, irregularly subquadrate, lightly sclerotized, extended most of length of apical segment. Anal setulae absent; anal gills simple, with 3 digitiform lobes, bases of lobes not contiguous, outer lobes divergent. Anterodorsal arm of anal sclerite moderately broad, tapered distally and rather pointed, moderately sclerotized with a heavily sclerotized ridge on inner margin, about ⅔ as long as posteroventral arm which is longer, slender and heavily sclerotized; posteroventral arm with a faint, nonsclerotized, linelike indication extending around abdomen from one arm to the other; arms broadly joined medially. Posterior circlet of hooks consisting of about 14 hooks in 68–76 rows. Ventral tubercles small, not well developed.

REMARKS: *Simulium mediovittatum* looks very much like *venator* and the two have been confused by various authors as can be seen from the literature listed in the synonymy. Both are densely pruinose, but the former species generally is more brownish in overall basic coloration with the central stripe brown, while the latter

species is generally much blacker overall with a dark brown to black median stripe. The females of the two species are easily separated on the basis of the anal lobe which in *mediovittatum* is very short with, at most, a slight ventral convexity or lobelike process that often is only barely discernible. The anal lobe of *venator* is considerably longer and has a ventral digitiform process that approaches that of *bivittatum* and *griseum* in length and shape. The thoracic pattern of the males is quite distinctive in that the scutum of *mediovittatum* has two large, submedian, triangular spots that strongly taper posteriorly and continue as two very slender pruinose stripes that merge with the pruinosity of the posterior declivity of the scutum. In *venator* the thoracic pattern consists of two smaller submedian, anterior, pruinose, triangular spots that do not continue as stripes and do not merge with the pruinosity of the posterior declivity of the scutum. The pupa of *mediovittatum* is distinctive in that it is the only species of the group that has the gill filaments branching (2+1) + (2+1) + (2). The larva is more difficult to characterize but can be distinguished by the features given in the key. Also, to my knowledge, this species is known only from Texas. Peterson's (1960b) record is undoubtedly based on a misidentification and possibly refers to *venator*. I have not seen specimens from Mexico and so can not verify its presence there.

The complete holotype female is mounted on a minuten pin on a block of soft wood attached to a regular insect pin. The pin extends upward at an angle between the fore and middle legs and emerges at the posterior corner of the scutum just at the wing base. The type female is in good condition but the right antenna is missing except for the scape, and the right corner of the scutum has a few grease spots. There are four labels on the pin. The label just below the specimen reads, "Bishopp No. 3938;" the next lower label reads, "Arlington X-28-14 TX;" the next to bottom label is a red USNM type label bearing the number "19635;" and the bottom label is the identification label, "*Simulium mediovittatum* Knab," apparently printed by Knab. The type resides in the collection of the U.S. National Museum, Washington, D.C.

SPECIMENS EXAMINED (total—110 males; 788 females; 1,801 pupae and pupal pelts; 1,482 larvae): TEXAS: *Bexar Co.,* April 3–June 21, (A). *Cameron Co.,* Oct. 16, (P, L). *Dimmit Co.,* June 21, (A). *Kerr Co.,* April 30–October 23, (A, P). *Kimble Co.,* May 8, (A, P). *Kinney Co.,* May 9–10, (A, P, L). *Maverick Co.,* July 17–September 12, (A). *Menard Co.,* February 16–October 9, (A, P, L). *Nueces Co.,* October 6–December 10, (A, P, L). *Pecos Co.,* January 24–October 17, (A). *Presidio Co.,* June 26–September 30, (A). *Real Co.,* May 11, (P, L). *Starr Co.,* April 26–December 15, (A, P, L). *Sutton Co.,* March 1, (A). *Tarrant Co.,* October 28, (A) (includes paratypes). *Terrell Co.,* June 10–October 14, (A). *Travis Co.,* July 16–October 17, (A, P, L). *Uvalde Co.,* April 21–May 11, (A, P, L). *Val Verde Co.,* May 9–October 13, (A, P, L). *Victoria Co.,* April 24, (A, P, L). *Zavala Co.,* June 21, (A).

PREVIOUS RECORDS: U.S.: Texas, Utah (misidentification). MEXICO: Chihuahua, San Luis Potosi, Tamaulipas, Veracruz.

BIOLOGICAL NOTES: This is a poorly known species and, to my knowledge, is unknown outside of Texas and northern Mexico, although I would not be surprised to see it in adjacent areas of extreme southern Arizona and New Mexico. The immature stages of this multivoltine species probably occur throughout most of the year, at least where the temperatures remain relatively high. They can be found largely on trailing vegetation, often in large numbers. Females have been reported to feed on horses and other farm animals (Stains and Knowlton, 1943; Wiseman and

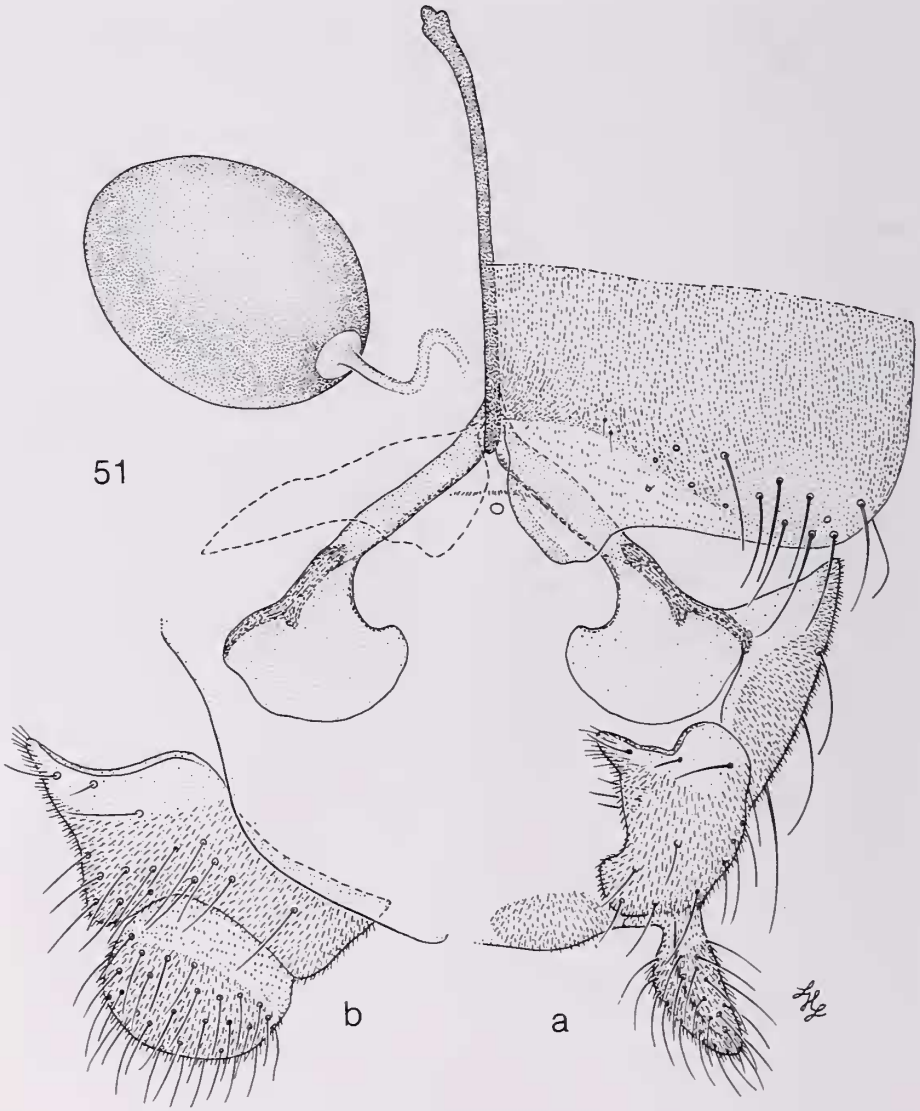


Fig. 51. *Simulium notatum*. 51. Female terminalia.

Eads, 1960; Jones et al., 1977), and humans (Travis et al., 1974). There are specimens in the USNM that were removed from burros, mules, ears of horses, and jackrabbits.

Simulium (*Psilopelmia*) *notatum* Adams
Fig. 51

Simulium notatum Adams, 1904:434 (♀, original description); Lectotype ♀ (here designated), 1 ♀ paralectotype (UKaL); Malloch, 1914:32 (♀, ♂, description, key,

catalog, plate 5, fig. 6) (misidentification, ♀ = *robynae* Peterson, n. sp.; ♂ identity unknown); Dyar and Shannon, 1927:36 (♀, ♂, description, key, figs. 88–89) (misidentification, ♀ = *robynae*; ♂ identity unknown); Enderlein, 1930:96 (citation); Essig, 1938:552 (on horses in New Mexico) (misidentification); Stains and Knowlton, 1943:278 (♀, description, distribution, key); Smart, 1945:510 (catalog, distribution); Vargas, 1945c:170 (catalog, synonymy, distribution); Pan Amer. Sanit. Bur., 1950:4 (literature reference); Wiseman and Eads, 1960:47 (wrongly recorded from Texas by Dyar and Shannon); Byers et al., 1962:164 (syntype depository); Travis, Lee and Labadan, 1969:132 (citation).

Simulium (*Neosimulium*) *notatum*, Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

Simulium (*Psilopelmia*) *notatum*, Stone, 1965:187 (catalog, distribution); Cole, 1969: 110 (citation, distribution); Crosskey, 1988:466 (list, distribution).

FEMALE. General body color yellowish orange, with a silvery white pruinosity. Length: body, 1.7 mm; wing, 1.8 mm.

Head dark brownish black, densely grayish white pruinose on occiput, frons and clypeus. Frons noticeably broad, at vertex slightly less than twice as wide as at narrowest point, slightly less than ½ width of head, and about as wide as long; sparsely covered with moderately long, decumbent, almost white pile. Clypeus concolorous with frons; slightly longer than wide; sparsely covered with moderately long, ventromedially directed, pale yellow to whitish pile. Occiput densely covered with long, pale yellow to whitish pile; postocular setae pale. Antennomeres yellowish orange, fine pubescence pale yellow; pedicel and first flagellomere subequal in length. Mandible with about 21 serrations on inner margin and 3–4 faintly discernible (under high magnification) serrations on outside margin. Blade of maxilla with 15–17 retrorse teeth. Palpus entirely pale yellowish orange, distal 2 segments slightly lighter than palpomere 3; with pale yellow setae; palpomere 5 subequal in length to palpomere 3. Sensory vesicle elongate, basally situated, about ½ as long as its segment, without a neck but with an anterodorsally directed, enlarged, ovoid mouth. Median proximal space of cibarium very shallow and broadly U-shaped, with a patch of about 12 setalike denticles on slight convexities on either side of a slight medial depression; dorsolateral arm short, rather broad, heavily sclerotized.

Thorax nearly uniformly yellowish orange, with a grayish white pruinosity that is more dense dorsally and on katepisternum; without any trace of stripes or markings on scutum in anterior and lateral views, but in posterior view, anterolateral corner of scutum with a small, grayish white pruinose spot [lectotype specimen pinned through middle of thorax so this area is obscured of any features that might be present]; scutum sparsely covered with short, recumbent, pale yellow pile which is longer along lateral and posterior margins and still longer posteromedially. Scutellum yellow, covered with long, pale yellow setae. Postnotum yellowish brown, with a dense pruinosity; anepisternal membrane slightly more pale yellow than rest of pleuron; mesepimeral tuft small, of pale yellow pile.

Wing membrane hyaline; veins yellowish. Base of costa and stem vein with pale yellow pile; rest of setae on veins pale yellow, spinules black; fringe of calypter and anal lobe pale yellow. Stem of halter yellowish orange, knob whitish, stem with short, pale pile.

Legs: Foreleg entirely yellow except for apical 4 tarsomeres that are brownish; foretarsus only slightly swollen. Midleg entirely yellow except apical 2 tarsomeres

brownish. Hind leg entirely yellow except extreme apical margin of tibia, including calcipala, and apical 2 tarsomeres brownish; hind basitarsus about 6 times as long as broad; calcipala hardly developed, brownish; pedisulcus small but distinct. Claw strongly curved from base, simple but base of claw slightly produced. Legs with pale yellow pile, some longer, erect, yellow setae present on posterior margins of tibiae and basitarsi.

Abdomen yellow, basal scale (tergite 1) yellow, with a fringe of long pale yellow pile; rest of setae on abdomen sparse, pale yellow; tergites 2–6 sclerotized, pruinose, brownish black, varyingly mottled with yellow, tergites 7–9 more grayish yellow; pleural membrane seemingly without dark markings; sternites weakly sclerotized; sternite 8 moderately sclerotized, mostly yellow but tinged with brown (partly due to greasing), bearing some long, pale yellow setae.

Terminalia as in Figure 51. Anal lobe narrow dorsally, broadened ventrally at level of lower margin of cercus where it protrudes shortly under cercus as a conspicuous, moderately setose, rounded convexity which then slightly recurves anteriorly and extends ventrally as a slender, sharp pointed, digitiform process that is somewhat longer than greatest width of anal lobe and about equal to height of cercus, its anterior margin strongly concave, and mostly shiny and bare except for about 6 minute but rather stout setae. Cercus subquadrate, only slightly higher than long, its hind margin strongly rounded; moderately setose. Hypogynial valve short, not extended to anterior margin of cercus, broadly rounded and nearly transparent posteriorly, medial margin broadly rounded, lightly sclerotized, narrowly separated basally from that of other side, valves divergent posteriorly but due to curvature most closely approach each other just posterior to base, lightly microsetose on about basal ½. Stem of genital fork long, heavily sclerotized, about twice as long as arm; in lateral view, strongly arched dorsally (internally) from junction with arms; arm moderately broad and relatively long, arms divergent from each other in a rounded V-shape, posteromedial corner and posterior margin of arm broadly rounded and moderately sclerotized, posterolateral corner and margin heavily sclerotized with a short, strong toothlike process on anteroventral margin that projects anteriorly less than ½ length of arm; arm narrowly attached to segment 9. Spermatheca elongate, shortly but distinctly longer than broad, heavily sclerotized, with a faint reticulate pattern that is difficult to see except at very high magnifications; with a narrow, circular, membranous area at junction with spermathecal duct.

MALE, PUPA, and LARVA. Unknown.

REMARKS: This species was described from two females collected by F. H. Snow. The lectotype, here designated, is labelled "Bill Wms. Fork, Ariz. July," [= Bill Williams River] [*Mohave/Lapaz Cos.*] and also has a red "Cotype" label that bears the name of the species. The paralectotype has similar labels except dated "Aug." instead of "July." No other collection data appear on the labels nor are given with Adam's original description. The lectotype is complete and in relatively good condition except that the apical portion of the left wing is missing. The head and abdomen of the lectotype were removed from the specimen, cleared, dissected, and placed in glycerine so the mouthparts and genitalia could be studied. These structures are in a microvial attached to the pin bearing the rest of the specimen. The lectotype was pinned through the middle of the scutum and so this structure is largely obscured, but it does not have a highly arched thorax. The paralectotype (cotype) is missing the head, abdomen, one wing and most of the legs. The two forelegs are present, one

is complete, the other is missing all tarsomeres but the basitarsus. The right midleg is missing all the tarsomeres. The left midleg, consisting of the femur, tibia and tarsus is stuck to part of the torn right wing. All the other legs and left wing are missing. The paralectotype is somewhat greasy and in poor condition. It probably is conspecific with the lectotype, but I can not definitely confirm this.

Adams mentioned nothing about the dorsum of the thorax being markedly convex and neither did Malloch (1914). However, Malloch's figure 6, on plate V, shows a very highly arched mesonotum of a female reported to be this species. This figure undoubtedly was prepared from a misidentified specimen, possibly of *S. robynae* Peterson, n. sp. Dyar and Shannon (1927) in their description of this species state, "... with a remarkably arched mesonotum;" probably basing their statement on Malloch's figure, or upon misidentified specimens, again possibly of *robynae* (see discussion under the latter species). Neither the lectotype or the paralectotype females of *S. notatum* have this type of thoracic architecture. The male ascribed to this species and described by Malloch (1914) also most likely belongs to some other species, again possibly one of the two new species described in this paper. The males examined by Malloch (1914), and Dyar and Shannon (1927), were not located and could not be examined for this study.

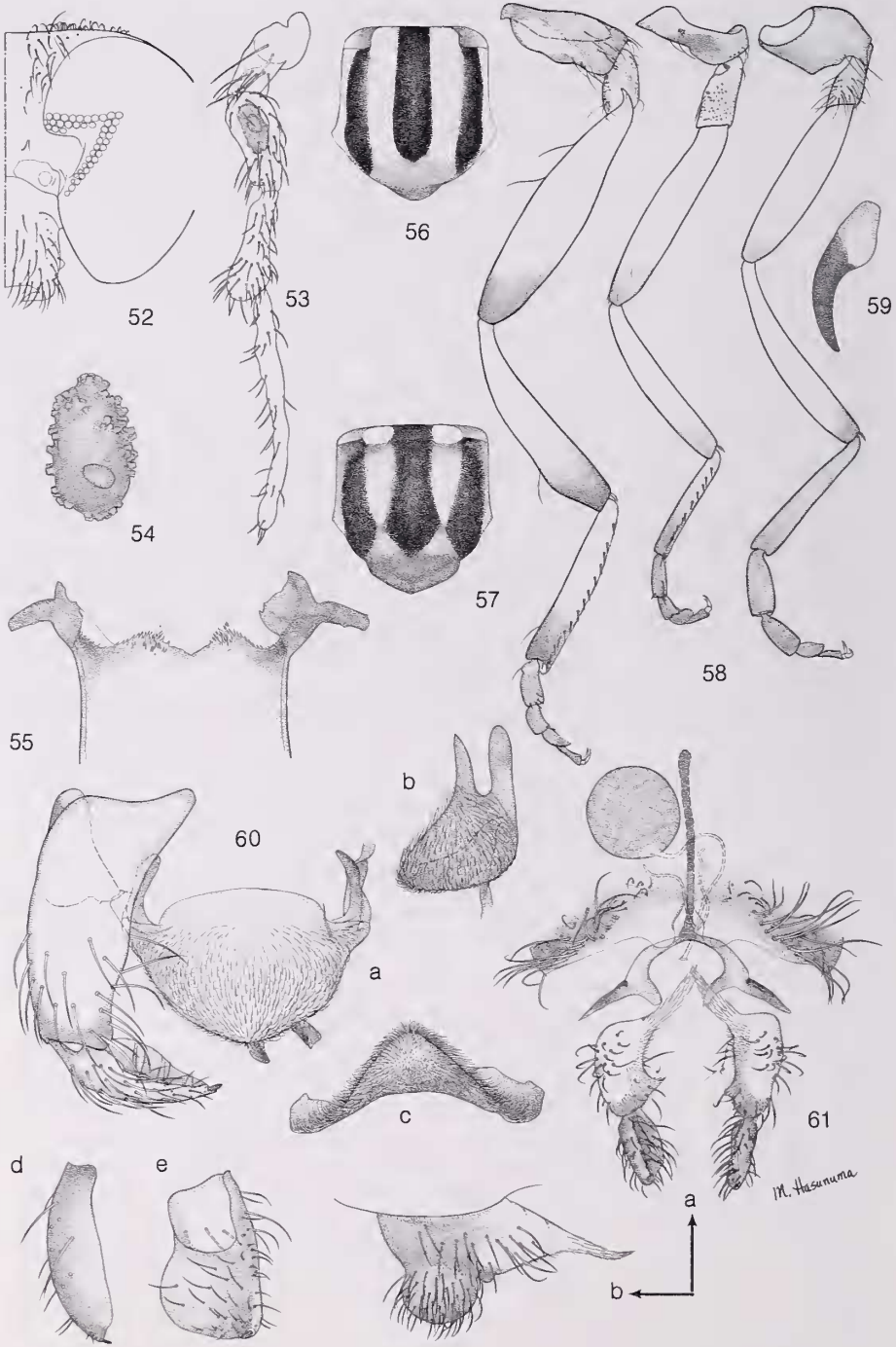
SPECIMENS EXAMINED: Lectotype ♀ and 1 paralectotype ♀ (see remarks).

PREVIOUS RECORDS: This species has been recorded from several states including Arizona, California, Nevada, New Mexico and Texas. All records, except those from the type locality in Arizona, undoubtedly are based on misidentifications, and probably apply to *venator* in Nevada, either *venator* or *griseum* in California, and *robynae* in New Mexico and Texas.

BIOLOGICAL NOTES: Nothing is known about the biology of this seemingly rare species.

Simulium (*Psilopelmia*) *trivittatum* Malloch
Figs. 52–67, 133–138

Simulium trivittatum Malloch, 1914:30 (♀, original description, key, catalog); holotype ♀, Type #15408 (USNM); Knab, 1915a:179 (as 1914) (♀, valid name for *S. distinctum* Malloch which is preoccupied); Dampf, 1927:129 (page 7 in reprint) (citation, Mexico); Dyar and Shannon, 1927:37 (♂, ♀, description, key, distribution, figs. 78–79, 115–116); Enderlein, 1930:96 (citation); Pinto, 1931:736 (synonymy, distribution in Mexico); Vargas, 1941:121 (distribution in Mexico); Vargas, 1942: 240 (♂, ♀, terminalia, fig. 13, synonymy); Lane and Vulcano, 1943:439 (♀ cibarial armature, fig. 22); Stains and Knowlton, 1943:279 (♀, distribution); Vargas, 1943: 363 (♂, ♀, pupa, figs. 19–27); Vargas, Díaz Nájera and Martínez Palacios, 1943: 288 (citation); Smart, 1944:134 (status of name); Smart, 1945:515 (catalog, distribution); Vargas, 1945a:65 (citation); Vargas, 1945c:202 (catalog, synonymy, distribution); Iriarte, 1946:466 (Mexico); Knowlton and Fronk, 1950:5 (Utah); Pan Amer. Sanit. Bur., 1950:143 (literature reference); Wygodzinsky, 1950:86 (pupa compared with that of *S. dinellii* (Joan)); Wygodzinsky, 1953:309 (pupa compared with that of *S. inaequalis* (Paterson and Shannon)); Peterson, 1955:114 (Utah): Rubtsov, 1956:748 (citation); Peterson, 1958:153 (Utah); Fredeen, 1959:73 (citation); Peterson, 1959:151 (around humans); Wiseman and Eads, 1960:47 (distribution in Texas); de Leon, 1963:133 (nonvector of Enfermedad de Robles);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Fallis, 1964:445 (feeding on animals and humans); Jenkins, 1964:23 (reference to parasites); Peters and Womeldorf, 1966:41 (biting humans, California); Rubtsov, 1963:531 (citation); Field, 1967:194 (citation); Travis and Labadan, 1967:237 (citation); Vulcano, 1967:22 (catalog, distribution); Field, 1969:284 (compared with *S. fuliginis* Field); Travis, Lee and Labadan, 1969:136 (citation); Forattini, Rabello and Cotrim, 1971:361 (specimens in collection of University of São Paulo); Tipton and Saunders, 1971:11 (Utah); Hall, 1974:65 (citation); Reisen, 1974:275 (biological notes); Travis, Vargas V. and Swartzwelder, 1974:191 (biting humans in Neotropical Region); Reisen, 1975a:27 (biological notes); Drummond, George and Kunz, 1988:5 (caused 10% reduction in milk flow). Crosskey, 1990:168 (citation).

Simulium (*Neosimulium*) *trivittatum,* Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

Simulium (*Simulium*) *trivittatum,* Vargas, 1945b:77 (♂, ♀, differentiated from those of *S. mangabeirai* Vargas).

Simulium (*Lanea*) *trivittatum,* Vargas, Martínez Palacios and Díaz Nájera, 1946:169 (♂, larva, keys, description, fig. 127); Vargas and Díaz Nájera, 1948a:70 (♀, key); Vargas and Díaz Nájera, 1948b:324 (♂, key, fig. 6); Vargas and Díaz Nájera, 1949: 288 (pupa, key); Dalmat, 1954:181 (Guatemala); Dalmat, 1955:156 (♂, ♀, pupa, larva, keys, descriptions, synonymy, biology, Guatemala, figs. 43–45, 160–162, 290, 330); Wirth and Stone, 1956:404 (♂, ♀, pupa, keys, California (pupa misidentified)); de Leon, 1963:133 (nonvector species).

Psilopelmia trivittatum, Rubtsov, 1968:361 (citation); Rubtsov and Garcia Avila, 1972:7 (citation).

Simulium (Psilopelmia) trivittatum, Vargas and Díaz Nájera, 1957:154 (♂, ♀, pupa, list, keys, distribution in Mexico, figs. 366–372; misidentification of at least pupa); Vargas and Díaz Nájera, 1958:14 (♂, ♀, pupa, keys, Mexico); Hidalgo Escalante, 1959:32 (pupa, larva, descriptions, biology, distribution, cuadro 2, map 6); Peterson, 1960b:100 (♂, ♀, pupa, keys, distribution, types, type localities); Díaz Nájera and Vulcano, 1961:221 (compared with *S.* (*P.*) *longithallum* Díaz Nájera and Vulcano); Anderson and Voskuil, 1963:127 (feeding on farm animals and humans); Stone, 1965:187 (catalog, synonymy, distribution); Cole, 1969:110 (California, New Mexico); Díaz Nájera, 1969:27 (compared with *S.* (*P.*) *gonzalezherrejoni* Díaz Nájera); Díaz Nájera, 1971:241 (larva, citation); Reisen, 1975b:949 (biological notes); Reisen, 1977:326 (biological notes); Coscarón, 1987:31 (list, distribution); Crosskey, 1988:467 (list, distribution).

Simulium distinctum Malloch, 1913:133 (♂, ♀, original description); holotype ♂, Type #15958 (USNM) (preoccupied Lutz, 1910:241); Malloch, 1914:30 nec Lutz (considered distinct from *S. trivittatum* Malloch); Knab, 1915a:179 (as 1914) (syn. of *trivittatum*); Dyar and Shannon, 1927:37 (syn. of *trivittatum*); Vargas, 1941:121

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Figs. 52–61. *Simulium trivittatum.* 52. Head of ♀. 53. Palpus of ♀. 54. Female sensory organ, enlarged. 55. Proximal end of ♀ cibarium showing armature. 56. Female thorax, dorsal view. 57. Male thorax, dorsal view. 58. Hind, mid-, and fore legs of ♀. 59. Claw of ♀. 60. Male terminalia. 61. Female terminalia.

(syn. of *trivittatum*); Vargas, 1942:240 (syn. of *trivittatum*); Smart, 1944:134 (status of name); Smart, 1945:115 (syn. of *trivittatum*); Vargas, 1945c:203 (syn. of *trivittatum*); Pan Amer. Sanit. Bur., 1950:143 (literature reference); Vulcano, 1967:22 (syn. of *trivittatum*); Travis, Lee and Labadan 1969:127 (citation).

Simulium (*Psilopelmia*) *distinctum* Malloch (preoccupied Lutz, 1910), Stone, 1965: 187 (syn. of *S.* (*P.*) *trivittatum*); Crosskey, 1988:467 (syn. of *trivittatum*).

FEMALE. General body color yellow to brownish yellow, with a silvery pruinosity. Length: body, 1.7–2.2 (av 1.9) mm; wing, 1.9–2.7 (av 2.3) mm.

Head dark brown to black, densely silvery pruinose. Frons moderately broad, widening above, at vertex about ⅔ as wide as at narrowest point, about ⅓ width of head, and nearly as wide as long; sparsely covered with moderately long, decumbent, pale yellow pile. Clypeus concolorous with frons; slightly longer than wide; sparsely covered with moderately long, pale yellow pile. Occiput moderately covered with relatively long, pale yellow pile; with both pale and black, short postocular setae. Antenna with scape and pedicel pale yellow, concolorous or slightly lighter than flagellum which is yellow to brownish yellow; pedicle subequal in width to first flagellomere; fine pubescence pale yellow. Mandible lightly sclerotized, with about 26 fine serrations on inner margin, and about 4 larger basal serrations continuous with 4 rounded, weak serrations distally and with a distinct apical bare area on outer margin. Blade of maxilla with 24 retrorse teeth. Palpus pale yellowish brown to brown, distal 2 palpomeres slightly paler than palpomere 3; with pale setae admixed with some brownish setae, sometimes brownish setae predominant; palpomere 5 about ⅓ longer than palpomere 3. Sensory vesicle of third palpomere rather large, slightly over ½ as long as its segment, proximally situated, its neck short, arising near middle and extended vertically, with a narrow ovoid mouth. Median proximal space of cibarium shallow, nearly twice as broad as deep, broadly U-shaped, with a shallow median notch flanked by 2 short, submedian lobes each bearing a variable series of very short, fine, setalike denticles; dorsolateral arm short, broad, and heavily sclerotized.

Thorax pale yellow to brownish. Postpronotum pale yellow, posteromedian corner tinged with brown; covered with moderately long, semi-erect to erect, pale yellow pile. Scutum yellow, with 7 alternating stripes of nearly uniform width; median and 2 sublateral stripes chocolate brown to dark brown; median stripe reaching anterior margin of thorax but terminating posteriorly just before prescutellar declivity; sublateral stripe usually terminating at postpronotal lobe with only a trace of brown extended forward onto posteromedian corner of this lobe, this brown stripe extended posteriorly almost to anterolateral corner of scutellum. Submedian and marginal stripes conspicuously silvery to whitish pruinose, marginal stripe extended around lateral and hind margins, submedian pale stripe united with posterior declivity that is broadly pruinose; notopleural ridge often faintly brownish; scutum densely covered with short, recumbent, pale setae on pale stripes and brown setae on dark stripes, pale pile longer along lateral margins and still longer and more erect posteromedially on declivity of scutum. Scutellum yellow tinged with brown; densely covered with long, mostly yellow setae, some of which have dark bases, and with some brownish setae usually present. Postnotum yellowish brown to dark brownish black, with a dense whitish pruinosity. Pleuron densely whitish pruinose; ground color varying from mostly pale yellow mottled with brown, to mostly brown; katepisternum brown; anepisternal membrane pale yellow; mesepimeral tuft pale yellow, sometimes with a faint golden tinge.

Wing membrane hyaline; veins yellowish to white. Stem vein and base of costa with pale yellow setae; fringe of calypter and anal lobe pale yellow. Halter yellowish white basally, knob white, with pale pile.

Legs: Foreleg yellow, tip of tibia faintly and narrowly tinged with brown; tarsomeres brown, slightly swollen. Midleg yellow, coxa tinged with brown, tip of femur faintly and narrowly tinged with brown, about apical ¼ of basitarsus brownish, apical ½ of 4th tarsomere and all remaining tarsomeres brown, sometimes 4th tarsomere entirely brown. Hind leg yellow, except coxa tinged with brown to all brown, femur brown on about apical ¼ and more extensively tinged with brown along dorsal margin on apical ½; tibia brown on apical ⅓ to ½, basitarsus brown on apical ½ and apical ½ of 4th tarsomere distal to pedisulcus and remaining tarsomeres brown; hind basitarsus about 5 times as long as broad; calcipala small, inconspicuous, pedisulcus small, inconspicuous but deep. Claw simple, evenly curved from near base, base sometimes pale yellow, rest of claw black. Legs with pale yellow setae on yellow portions, and dark setae on brown portions, hind femur with some brownish setae along dorsal margin; hind margins of posterior tibia and tarsus with 3 or 4 dark setae that are much longer than others.

Abdomen grayish yellow; basal scale (tergite 1) more yellowish, hind marginal area brownish, with a fringe of long pale yellow pile; tergites 2–6 sclerotized, dark matte brown, moderately and evenly covered by short, recumbent, yellow and brownish setae; tergites 7–9 uniformly grayish yellow, with longer, mostly yellow setae but a few brownish setae may be present; pleural membrane of segments 3–7 with subquadrate dark markings, segment 2 sometimes with a small, faint brown spot; sparsely covered with short pale setae, and with dark setae on brown spots. Sternites 1–7 weakly sclerotized, scarcely evident, sternite 8 heavily sclerotized, dark brown, with long, dark brown setae. Terminalia as in Figure 61. Anal lobe not produced beneath cercus, broad dorsally, with a small but usually distinct posteriorly directed bump just below cercus, then tapered ventrally to a long, slender, fingerlike, setose process that is distinctly longer than distance from dorsal margin of anal lobe to ventral margin of bump, and is about ⅖ as long as height of cercus; this ventral process somewhat variable in thickness. Cercus subquadrate, about as high as long, hind margin strongly rounded. Hypogynial valve short, not reaching level of cercus, with a small, transparent, bare, rounded lobe; lobes of each side diverging distally, separated by a distance greater than distal width of a lobe; medial margin of lobe scarcely sclerotized; lightly microtrichose basomedially and along proximal margin. Stem of genital fork long, moderately sclerotized, about ⅔ longer than arm; arm short, and with a prominent, sclerotized, toothlike process on anterolateral margin; arm narrowly attached to tergite 9. Spermatheca globular, moderately sclerotized, with a faint, loose, reticulate pattern.

MALE. General body color black. Length: body, 1.6–2.6 (av 2.1) mm; wing, 1.7–2.0 (av 1.8) mm.

Frons and clypeus densely pruinose, medial marginal area between eyes, and clypeus with pale brownish to pale yellowish pile. Occiput with long, pale yellow setae. Antenna yellow; pedicel and first flagellomere equal in length; fine pubescence pale yellow. Palpus brown to black, with mostly coppery brown pile; palpomere 5 slightly more than twice as long as palpomere 3. Sensory vesicle about 1/6 to ¼ as long as its segment; neck short, with a small round mouth.

Postpronotum yellow except for medial corner which is black and continuous with black sublateral stripe of scutum; grayish pruinose; with pale yellow pile. Scutum black, but with 7 alternating stripes as follows: each lateral margin yellow, and 2

submedian stripes with a variously intense yellow ground color, all brightly grayish pruinose and united with pruinosity of posterior declivity, plus a median and 2 sublateral matte black stripes that are wider than pruinose stripes; scutum densely covered with short, recumbent, pale yellow pile that is longer laterally and posteromedially, setae on black stripes appear coppery brown in anterior view. Scutellum yellowish brown, paler than scutum; densely covered with long, yellow setae some of which may have dark bases, interspersed with some entirely black setae. Postnotum concolorous with or slightly paler than scutum, lightly pruinose. Pleuron varying from black to yellowish brown, densely grayish pruinose; anepisternal membrane usually paler brownish to yellowish gray; mesepimeral tuft brownish.

Wing membrane hyaline; veins pale yellow; base of costa and stem vein with mixed yellow and black setae although sometimes black setae are most numerous; fringe of calypter and anal lobe varying from all pale yellow to some with black bases to mixed brownish and yellowish setae. Knob of halter usually white but sometimes yellow, stem brown with mostly brownish setae.

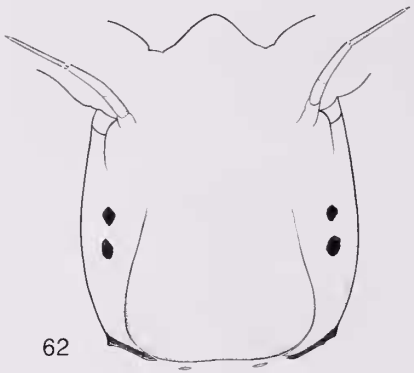
Foreleg yellow except for apical ¼ to ⅓ of tibia, and tarsus which are black, with mostly pale yellow setae except for a few long, black setae posterodorsally on femur, and black to coppery brown setae on tarsus; midleg yellow except tibia may be tinged with black apically on dorsal surface, and apical ⅓ to ½ of basitarsus and remaining tarsomeres which are black, with mostly yellow setae except black setae present on dark areas and near tip of tibia; hind leg black except yellow on basal ¼ to ½ of femur and tibia, basal ⅔ to ¾ of basitarsus, and basal ½ of second tarsomere, with mostly pale yellow setae on yellow areas and black setae on black areas; however, femur, and especially tibia with a few long, black dorsal setae; hind basitarsus varying from 4.6 to 6.5 times as long as broad.

Abdomen mostly black dorsally, grayish yellow laterally and ventrally; anterior ½ of basal scale yellow and posterior ½ black, with a fringe of long pile varying from pale yellow with dark bases, to mixed pale yellow and coppery brown, to all brown or black; tergites 2, 6 and 7 each with a central black spot and lateral ⅓ or more yellowish brown and densely grayish pruinose; tergites 3–5 and 8–9 black; tergites moderately covered with short, pale yellow and coppery brown setae dorsally, and longer pale yellow to brownish pile laterally; tergite 10 small, rectangular to subquadrate, varying from about equal in length and width to bout ⅕ wider than long; sternites 3–8 nearly equal in size, rectangular, lightly sclerotized, sparsely clothed with short, yellowish brown to black setae on posterior ½.

Terminalia as in Figure 60. Gonocoxite rectangular, tapered distally, slightly but distinctly longer than greatest width, sparsely covered with pile on distal ⅔. Gonostylus short, 1.5–2.0 times as long as greatest width at base; apical margin with outer corner broadly rounded, obliquely continuous to inner distal corner that is produced as a short but distinct, triangular process bearing one tiny terminal spine, this process accentuated by concave inner margin of gonostylus. Ventral plate of aedeagus broadly subtriangular; in ventral view, greatest width occurring just distal to basal arms, lateral margins tapered distally to apical margin which, in flat view, is straight or slightly convex, or if basal arms somewhat tilted ventrally (inwardly) then apical margin curved with a short, broadly rounded, median point, proximal margin between basal arms variously convex medially; basal arm short, heavily sclerotized, broad, tapered to a pointed apex; in lateral view, apical margin with a short, ventral lip; both dorsal and ventral surfaces densely setose. Median sclerite of aedeagus short, stem often slightly longer than arms or these subequal in length, stem

sclerotized, with a series of concentric appearing folds or ridges that extend into basal portion of each arm; arms less sclerotized, well differentiated, slightly widened distally, outer surface of hoodlike covering lightly sclerotized, less so around gonopore; aedeagal membrane densely covered with irregular and clumplike to comblike series of minute setulae having conspicuous bases (appears granular). Plate of endoparameral organ subrectangular, distal (posterior) margin thickened rimlike, with a few ridgelike cuticular thickenings, remainder of plate smooth; arm short, twisting inwardly, ventrally then dorsally roughly in an S-like configuration, with 4 or 5 broad, long, well developed, basal spines that merge with a cluster of 25–35 smaller, more irregular, weakly defined apical spines.

PUPA. Length 2.2–2.8 (av 2.5) mm. Respiratory organ (Fig. 68) 2.2–2.8 (av 2.5) mm, often as long as pupa or nearly so; consisting of a very short, slender base, covered with minute comblike ridges loosely arranged scalelike, and minute spicules; with 6 filaments arranged in 3 pairs (sometimes dorsalmost filament of outer dorsolateral branch with a secondary filament that arises a considerable distance from base and results in a total of 7 filaments); petiole of inner mediolateral pair long, often nearly twice as long as others, sometimes arising from base of outer dorsolateral pair of filaments and sometimes arising separately; petioles of outer dorsolateral and ventrolateral pairs variable but usually subequal in length; filaments pale whitish to grayish, with closely placed, irregular and poorly defined, annulations. Head sparsely to moderately covered by small, raised granules that are arranged singly or in small groups, sometimes integument largely glossy; antennal sheath of male short, reaching only about ⅓ distance to hind margin of head; antennal sheath of female reaching about ⅝ distance to hind margin of head; frons with 2 short, pale, curved or straight, simple setae just mediodorsal to base of antenna; clypeus with a short forked, pale seta medioventral to base of antenna. Dorsum of thorax with sparse to moderately dense, small, raised granules that are arranged singly or in small irregular clusters, when granules sparse integument appearing glossy; with 3–5, usually 4, short, slender, pale, simple or bifurcate trichomes laterally above level of base of respiratory organ. Chaetotaxy of each lateral half of abdominal tergites as follows: tergite 1 largely bare, with 1 or 2 anterolateral setae and 3 to 4 tiny posteromedial setae that are difficult to see; tergite 2 with a sublateral longitudinal series of 2–3 setae and a posteromedial row of 4 short but more distinct setae; tergites 3 and 4 each with a sublateral row of 4 stout, anteriorly directed hooks near hind margin and a slightly more anterior single seta; tergite 5 bare; tergites 6–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, those of tergites 6 and 7 broadly interrupted in middle, those of tergites 8 and 9 entire or only narrowly interrupted at middle; caudal spines very short, straight, tips subparallel to slightly divergent, bases widely separated, each situated on a slightly swollen convexity. Chaetotaxy of each lateral half of sternites as follows: sternites 2–3 each with 1 or 2 small submedian setae; sternite 4 with 1 small, slender, submedian hook and 1 seta just anteromedial to hook, hook smaller than those of following segments; sternite 5 with 2 closely placed submedian hooks; sternites 6–7 each with 4 longer, rather stout hooks, lateral hooks of each pair separated from submedian hook but not lying in pleural membrane, hooks varying from simple to bifid to trifid; sternites 8–9 usually bare but sometimes with 1 or 2 fine setae. Cocoon grayish, slipper-shaped and tightly woven, anterior margin simple, only slightly thickened; floor well formed, extended anteriorly about ½ length of cocoon; in lateral view, anterior margin of cocoon weakly concave and slightly slanted anteroventrally so anteroventral corners extend in front of dorsal margin of cocoon.



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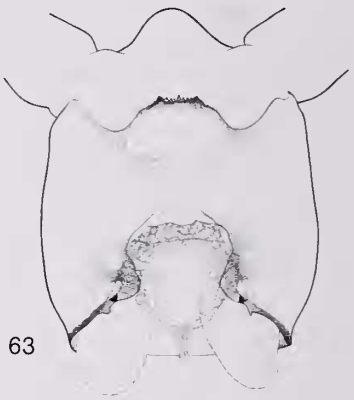

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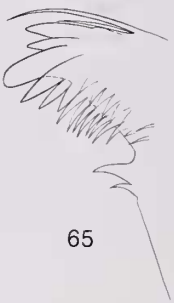

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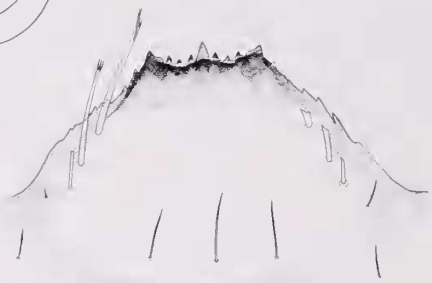

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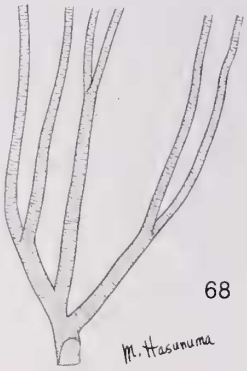

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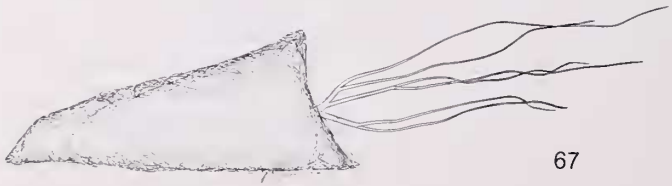

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LARVA. Length 4.2–5.8 (av 4.9) mm. Body color dorsally pale brownish yellow to grayish yellow anteriorly, posterior segments darker brownish yellow, entire abdomen ventrally more transparent whitish, intersegmental lines rather broad, slightly lighter than rest of abdomen. Head capsule (Figs. 62, 63) pale yellow to light brownish yellow, postgena often slightly darker; head spot pattern similar to that of *mediovittatum,* spots mostly obscure except posteromedian spot which is large, pale yellow, and entirely surrounded by a narrow, darker brown, ringlike area that widens posteriorly to encompass 2 posterolateral spots, area anterior to head spots entirely pale yellow verging to transparent. Antenna in fresh specimens entirely brown (as dark as mandibular phragma) except for base of proximal segment and extreme apex of second segment and base of distal segment which are colorless, in older specimens this coloration fades to a paler brownish color; slightly longer to subequal in length to stalk of labral fan; proportions of segments (basal to apical) about 15:15:16. Labral fan with 34–36 primary rays. Hypostoma as in Figure 66; median tooth distinctly longer than outer lateral teeth which are only slightly longer than well developed sublateral teeth, with 2 well developed paralateral teeth and 3–4 lateral serrations; 3–5 lateral hypostomal setae that decrease in length posteriorly and with 2–3 pairs of shorter sublateral setae near posterior margin of hypostoma. Hypostomal cleft broadly rounded, anterior margin variably distinct, usually somewhat longer than wide, extended about ½ distance to base of hypostoma; hypostomal cleft, hypostomal bridge and hypostoma all subequal in length. Mandible with 5–6 apical teeth only 2 of which are stouter than others; dorsal process near base of primary teeth distinct, slender and heavily sclerotized; about 8 very fine and difficult to see combteeth; inner subapical ridge usually with 1 variably sized but usually relatively large serration, occasionally a much smaller second serration present adjacent proximally to base of larger serration. Maxillary palpus about 4 times as long as width at base, tapered distally. Lateral plate of proleg moderately broad, lightly sclerotized, extended about ½ length of apical segment; circlet of apical hooks in about 25–28 rows. Anal setulae few, very minute and widely scattered; anal papillae usually consisting of 3 simple lobes whose bases are situated close together, and outer lobes divergent, but not strongly so, from middle lobe; outer lobes frequently with a much smaller lobule or an indication of a secondary lobule at base posteriorly, more rarely 2 secondary lobules present, median lobe less frequently with 1 or 2 secondary lobules at base posteriorly (1 specimen was noted to have only 2 primary lobes). Anterodorsal arm of anal sclerite moderately broad, tapered and bluntly pointed distally, weakly to moderately sclerotized, varying from just slightly to about ⅛ shorter than posteroventral arm which is slender and heavily sclerotized. Posterior circlet of hooks consisting of about 12 hooks in 61–70 rows. Ventral tubercles small but distinct.

REMARKS: The current description of the female was based on a series of reared specimens, and consequently the colors might be somewhat darker in field caught specimens than is evident in the material at hand. Greasy specimens also appear

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Figs. 62–68. *Simulium trivittatum.* 62. Head capsule of larva, dorsal view. 63. Head capsule of larva, ventral view. 64. Respiratory histoblast of mature larva. 65. Tip of mandible of larva. 66. Hypostoma of larva. 67. Cocoon and pupa, lateral view. 68. Basal portion of respiratory organ of pupa.

darker than the colors described above. In available female specimens, the ventral digitiform process of the anal lobe varied somewhat in its length and thickness but is quite slender. This process on the holotype female of *trivittatum,* several specimens from eastern Texas, and a paratype female of *S. distinctum* Malloch, is relatively long and stout whereas in other females it is slightly shorter and more slender. However, I consider this difference to be within the normal range of variation. What is considered here as *trivittatum,* based upon examination of the holotype, is not the same species as specimens in the USNM collection bearing this name from parts of Mexico and Guatemala south to Peru. Specimens from the latter countries have dark pile on the stem vein, and the ventral prolongation of the anal lobe of the female is thicker and more pilose; these specimens probably represent an undescribed species. The previous reports of *trivittatum* from Mexico and Guatemala have not been verified, and may or may not represent true *trivittatum.*

The pupa shows some variation in the density of the small granules on the frons, clypeus, and dorsum of the thorax. In most cases these granules are moderately dense and easily distinguished. More rarely these granules are few and widely distributed giving the integument a more glossy appearance. Adults from the two types of pupae cannot be differentiated and this variation is considered within the normal range of variation for the species. Also, and again more rarely, the dorsal filament of the dorsolateral group produces a secondary filament usually some distance from the base, resulting in 7 filaments instead of the usual 6. Pupae of the two forms agree in all other respects.

The pinned holotype female of *trivittatum* is in reasonably good condition except the left flagellum of the antenna and the left wing are missing, as are the distal four tarsomeres of the left middle leg, the femur of the left hind leg, and all the tarsomeres of the right hind leg. The tibia and tarsus of the left hind leg are detached and stuck to the right middle leg. The uppermost label on the pin reads, "Tampico Mex. 17.12." The next lower label reads, "EA Schwarz Collector." The next to bottom label is a red type label bearing the type number 15408, U.S.N.M., and the bottom label is Malloch's identification label reading, "*Simulium trivittatum* Malloch." The prolongations of the anal lobes are clearly visible.

The holotype male of *distinctum* is also pinned, and at the time of this writing, is complete and in good condition except that the eyes are collapsed. The scutal pattern of *distinctum* matches that of *trivittatum* and the two species are synonyms. There is a mite attached to the venter just behind the right hind leg. The uppermost label on the pin says, "Devil Riv. v.5.07 Tx." The next lower label is much smaller and says, "at light." The third or middle label says, "Bishopp & Pratt coll." The next to bottom label is a red type label bearing the number 15958 U.S.N.M., and the bottom label is Malloch's identification label reading, "*Simulium distinctum* Malloch (Type)."

SPECIMENS EXAMINED (total—302 males; 276 females; 931 pupae and pupal skins; 2,757 larvae): ARIZONA: *Cochise Co.,* April 13–June, (A). CALIFORNIA: *Butte Co.,* June 5, (A). *Fresno Co.,* June–July (A). *Inyo Co.,* May 10, (P). *Kern Co.,* July 29, (A). *Merced Co.,* September, (A). *Riverside Co.,* May 10–28, (A). *San Bernardino Co.,* March 2–December 13, (A). *Shasta Co.,* August 1, (A). *Yolo Co.,* October, (A). NEW MEXICO: *Bernalillo Co.,* June 18, (A). *Catron Co.,* June 1, (A). *Eddy Co.,* May 6–14, (A, P, L). *Sandoval Co.,* July 4, (A). *Taos Co.,* May 26, (A). OKLAHOMA: Sheep Creek, Ada, October 15, 1937, K. & R. Weddle, (A). TEXAS:

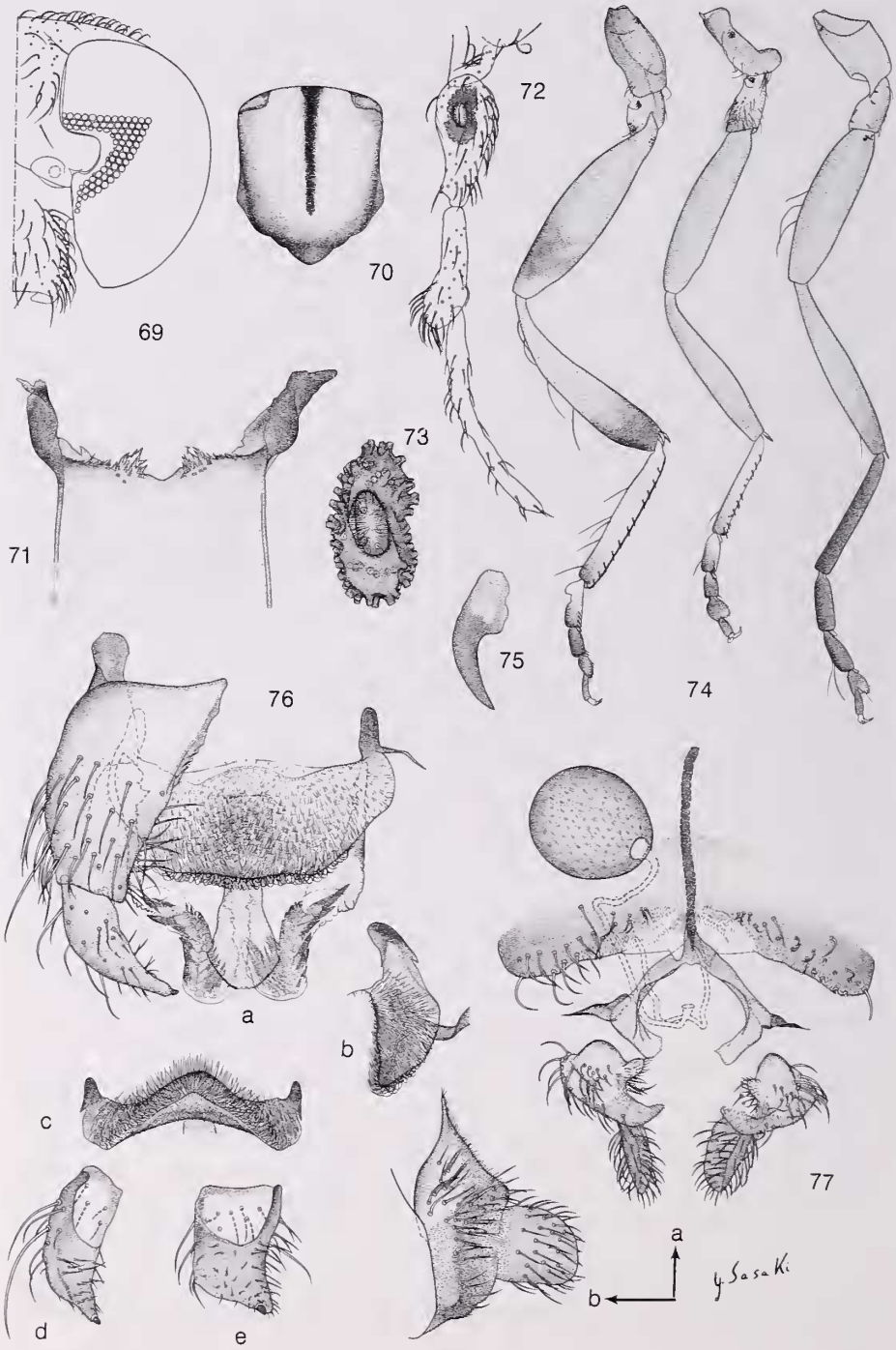
Bandera Co., March 1–October 16, (A, P, L). *Brewster Co.,* May 11, (A, P). *Burnet Co.,* February 2, (P, L). *Edwards Co.,* March 27–April 22, (A, P, L). *Kerr Co.,* February 11–November, (A, P, L). *Kimble Co.,* February 19–May 8, (A, P, L). *Kinney Co.,* May 9–10, (A, P, L). *Maverick Co.,* May 9, (A, P, L). *Menard Co.,* April 23–October 9, (A, P, L). *Pecos Co.,* October 17, (A). *Real Co.,* March 27–June 26, (A, P, L). *Travis Co.,* July 28, (P, L). *Uvalde Co.,* April 20–June 13, (A, P, L). *Val Verde Co.,* April 20–June 13, (A, P, L) (includes paratypes). *Williamson Co.,* April 18, (A, P, L).

PREVIOUS RECORDS: U.S.: Arizona, California, Montana, New Mexico, Oklahoma, Texas, Utah. MEXICO: Aguascalientes, Coahuila, Colima, Chihuahua, Guanajuato, Guerrero, Jalisco, Michoacan, Morelos, Nuevo Leon, Oaxaca, Puebla, San Luis Potosi, Tamaulipas, Veracruz, Zacatecas. GUATEMALA: Chimaltenango.

BIOLOGICAL NOTES: Despite the fact that this is a fairly widespread species, there is relatively little known about its biology, and what has been reported must be considered suspect. This arises from the fact that *trivittatum* has been recorded from as far south as Guatemala (and there are specimens in the USNM collection from Peru labelled as *trivittatum*). Although I did not conduct a detailed study of these specimens as part of this revision, it is clear that at least some of the Central and northern South American specimens in the USNM are not conspecific with the North American species, and thus the biological information reported for the more southern collections could apply to one or more species. As a result, I have confined my literature citations, as far as biological data is concerned, to that reported on North American collections of *trivittatum.*

This multivoltine species often occurs with *mediovittatum* or in the same type of habitats within its range outside of Texas. Immatures probably can be found through most of the year in the warmer, more southern regions of its range. Females have been reported to feed on farm animals as well as humans (Anderson and Voskuil, 1963; Fallis, 1964; Peters and Womeldorf, 1966; Drummond et al., 1988). Both Anderson and Voskuil (1963), and Peters and Womeldorf (1966) reported reduced milk production in cows bothered by this species. Specimens collected from the ears of horses are housed in the USNM collection. Some general remarks on various aspects of the biology of this species have been given by Reisen (1974, 1975a,b), and Jenkins (1964) lists the parasites that have been recorded from *trivittatum.* One intersex specimen (Topanga Canyon, Los Angeles, California, May 14, 1952) was discovered whose head has female eyes but whose frons is narrow and decreases in width dorsally, the blade of the maxilla has a reduced number of retrorse teeth, and the mandible has only a few weak indications of serrations. The palpus is female with the typical, but slightly reduced, sensory organ of the third palpomere. All legs have typical male claws, and the cerci are small. The abdomen bears both male and female genital components although most of these are deformed. The hypogynial valves are present and just lateral to them are the paired gonocoxites and gonostyli. Internally there are the genital fork and spermatheca, but there are no traces of the ventral plate or median sclerite of the aedeagus, although the arms of the parameres are present with well defined spines.

Some of the literature treating various aspects of the biology of specimens identified as *trivittatum* from Central and South America include the following: Dalmat (1955), Hidalgo Escalante (1959), de Leon (1963), and Travis et al. (1974).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Y. Sasaki

Simulium (*Psilopelmia*) *venator* Dyar and Shannon
Figs. 69–80, 139–143

Simulium venator Dyar and Shannon, 1927:36 (♂, ♀, original description, keys, distribution, figs. 92–93); holotype ♀, Type #28343 (USNM); Hearle, 1932:18 (citation); Knowlton, 1935:1073 (attacking horses); Knowlton, Harmston and Hardy, 1938:104 (Idaho, Utah); Twinn, 1938:54 (Idaho, Utah); Stains and Knowlton, 1943:279 (syn. of *S. mediovittatum* Knab); Smart, 1945:508 (syn. of *meddiovittatum* [sic] (apud Stains and Knowlton, 1943); Vargas, 1945c:159 (syn. of *mediovittatum*); Knowlton and Fronk, 1950:6 (Utah); Pan Amer. Sanit. Bur., 1950: 144 (literature reference); Peterson, 1955:114 (Utah); Peterson, 1959:151 (citation); Fallis, 1964:445 (on horse); Travis, Lee and Labadan, 1969:137 (citation); Tipton and Saunders, 1971:11 (Utah).

Simulium (*Neosimulium*) *venator,* Rubtsov, 1940:130 (assigned to subgenus *Neosimulium*).

Simulium (*Lanea*) *venator,* Wirth and Stone, 1956:404 (♂, ♀, keys, California).

Simulium (*Psilopelmia*) *venator,* Peterson, 1960b:100 (♂, ♀, keys, distribution, type, type locality); Stone, 1965:187 (catalog, distribution); Cole, 1969:110 (California, Nevada); Crosskey, 1988:467 (list, distribution). Crosskey and Lowry, 1990:233 (paratype in BM(NH)).

Simulium beameri Stains and Knowlton, 1943:279 (♂, ♀, original description, key, distribution, figs. 70, 80); holotype ♀ (UKaL); Smart, 1945:501 (catalog as valid species); Vargas, 1945c:119 (catalog as valid species); Byers et al., 1962:164 (type depository); Travis, Lee and Labadan, 1969:124 (citation).

Simulium (*Lanea*) *beameri,* Vargas, Martínez Palacios and Díaz Nájera, 1946:107 (citation).

Simulium (*Psilopelmia*) *beameri,* Stone, 1965:187 (catalog, syn. of *S. venator* Dyar and Shannon); Cole, 1969:110 (syn. of *venator*); Crosskey, 1988:467 (syn. of *venator*).

FEMALE: General body color varying from dark yellowish brown to black. Length: body, 1.4–2.2 (av 1.8) mm; wing, 1.9–2.5 (av 2.2) mm.

Head entirely black, densely grayish pruinose. Frons moderately broad, at vertex only slightly wider than at narrowest point and as wide as long, about ⅓ width of head or slightly more; sparsely covered with moderately long, whitish pile. Clypeus concolorous with frons; at most, slightly longer than wide; sparsely covered with moderately long, whitish pile. Occiput moderately covered with long, whitish pile. Antenna with scape and pedicel yellow with yellowish setae, flagellum brownish yellow, darker dorsally, paler ventrally, sometimes flagellum quite brown especially in dried specimens; fine pubescence pale yellow; first flagellomere slightly longer and wider than pedicel, remaining flagellomeres, except terminal flagellomere, subrectangular, nearly twice as wide as long. Mandible moderately sclerotized along inner

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Figs. 69–77. *Simulium venator.* 69. Head of ♀. 70. Female thorax, dorsal view. 71. Proximal end of ♀ cibarium showing armature. 72. Palpus of ♀. 73. Female sensory organ, enlarged. 74. Hind, mid-, and fore legs of ♀. 75. Claw of ♀. 76. Male terminalia. 77. Female terminalia.

margin with about 20–25 very small serrations, thinner and more weakly sclerotized along outer margin with only 3 or 4 larger but much weaker and rather widely spaced serrations. Blade of maxilla with about 23 well developed, retrorse teeth. Palpus dark brown to black with pale yellowish setae, sometimes 4th and 5th palpomeres slightly paler and more yellowish; palpomeres 3 and 4 subequal in length, palpomere 5 somewhat variable in length but usually about ⅓ longer than palpomere 3. Sensory vesicle moderately long and slender, situated basally, often at extreme base, and about ½ to ¾ as long as its segment, without a neck or, at most, a faint indication of a neck that arises medially and with an enlarged ovoid mouth. Median proximal space of cibarium shallow and broadly U-shaped, each side with a short, sharply pointed, sublateral projection that is continuous with a sclerotized strut from lateral arm, each projection separated by a rather wide bare area, and bearing a series of about 14 minute denticles, some of which are slender and setalike, these denticles extended laterally to base of lateral arm; dorsolateral arm short, broad, heavily sclerotized and rounded distally.

Thoracic color pattern quite variable but usually as follows for pinned specimens: lobe of prescutum small, usually yellow with pale yellow pile, but lobe sometimes brownish to blackish. Postpronotum usually yellow, sometimes darker brownish to black but mostly with traces of yellow along edges, and with an overlying grayish pruinosity; moderately covered with long, semi-erect to erect, pale yellow pile. Scutum with anterior and lateral margins narrowly yellow or if brownish or black then tinged with yellow; with 2 broad sublateral black bands that extend to or just short of lateral corners of scutellum and variably unite across posterior declivity of scutum, sometimes broadly united, sometimes more narrowly so or just in front of scutellum, and sometimes they do not unite at all with posterior declivity which is yellowish; between these sublateral bands there is a much narrower, straight, orange brown stripe that is bordered with darker brownish or blackish areas but with a distinct yellowish tinge, this central stripe extended to prescutum with its anterior portion distinctly black and spotlike, posteriorly this central stripe terminates abruptly at posterior declivity of scutum but sometimes it fades into yellowish brown or black area of posterior declivity; entire scutum with a dense grayish pruinosity that somewhat obscures underlying pattern except for median stripe which is without pruinosity; anterolateral corner of scutum between postpronotum and median stripe often with a distinct triangular grayish spot that is more densely pruinose than rest of scutum; scutum dorsally moderately covered with short, recumbent, pale yellow pile, lateral margin and posterior declivity with longer, more erect, pale yellow pile. Scutellum yellow to brownish yellow, densely covered with long, pale yellow setae. Postnotum brownish black, densely grayish pruinose. Pleuron black anteriorly, variably more yellow, often mottled with darker areas, medially and posteriorly, grayish pruinose; anepisternal membrane varying from brownish black to yellow, often mottled, and grayish pruinose; mesepimeral tuft pale yellow.

Wing membrane hyaline; veins yellowish; base of costa and stem vein with pale yellow pile; fringe of calypter and anal lobe pale yellow. Halter pale yellow with pale yellow setae.

Legs: Foreleg yellow except for slender tarsus which is black, sometimes about basal ¼ of first tarsomere yellowish, setae of yellow areas pale yellow, those of black areas largely black but mixed with some pale yellow setae. Midleg and hind leg each

with coxa black, trochanter, femur, tibia and all but tips of basal 2 tarsomeres yellow, tips of these segments and remaining tarsomeres black, sometimes hind femur slightly brownish dorsally and tibia darkened on about apical ¼; setae pale yellow on yellow parts of legs and black on black parts of tarsi; hind basitarsus slender, parallel sided, about 7 times as long as broad. Claw short, slender, simple, evenly curved from base.

Abdomen largely pale yellow, basal scale (tergite 1) with fringe of long, pale yellow pile; tergites 2–7 each with a small, subquadrate brown to black median spot, those of tergites 2 and 7 smaller, paler and more diffuse, tergites 2 and 4 each with a more elongate gray mark on each side ventral to tergite, tergites 8 and 9 heavily sclerotized and dark brown to black; setae of tergites rather sparse and largely pale yellow except for some dark setae on darkened areas of tergites and laterally on grayish spots of segments 2 and 4; sternites weakly sclerotized and difficult to discern, sparsely covered with short, pale yellow setae; sternite 8 weakly sclerotized on about anterior ⅔ and heavily sclerotized and dark brown to black on about posterior ⅓, darkened area with patch of longer black setae. Terminalia as in Figure 77. Anal lobe narrow dorsally, slightly longer than portion ventral to cercus, with a slender, vertical, sclerotized strip bearing a row of about 12–14 longer setae; anal lobe broadened ventrally below cercus, posterior margin with a small but noticeable tuberclelike process bearing 1 or 2 longer, stout setae, this process not extended posteriorly below ventral margin of cercus or only faintly so, ventral margin of anal lobe produced as a slender digitate lobe with a series of short setae along hind margin, anterior margin bulging anteriorly then curved posteriorly to form a bare anterior margin; length of anal lobe ventral to cercus distinctly greater than greatest width at level of ventral margin of cercus; anal lobe moderately setose with both short and longer setae. Cercus subquadrate, slightly higher than long, hind margin strongly rounded. Hypogynial valve short, not reaching cercus, broadly rounded posteriorly, medial margin lightly sclerotized, both lobes rather widely separated and diverging distally; lightly setose. Stem of genital fork long, slender, heavily sclerotized, about 3 times as long as arm; arms short, slender, widely divergent, each expanded apically into a moderately large, subquadrate plate with a short, toothlike process on anterodorsal margin; arm narrowly attached to tergite 9. Spermatheca somewhat ovate, longer than broad, slightly tapered toward spermathecal duct, heavily sclerotized, with a small rounded membranous area at junction with spermathecal duct.

MALE. General body color black. Length: body, 1.9–2.9 (av 2.4) mm; wing, 1.9–2.4 (av 2.1) mm.

Medial marginal area between eyes, upper margin of frons, and clypeus with erect, pale yellow pile. Occiput with long, pale yellow setae. Antenna, in alcohol preserved specimens, entirely yellow to pale brown; in dried specimens, yellowish brown to black but with base of first flagellomere yellow; first flagellomere about ¼ longer than pedicel; fine pubescence pale yellow. Palpomere 3 black, 4 and 5 paler brownish, all with yellow pile interspersed with black setae; palpomere 5 slightly more than twice as long as palpomere 3. Sensory vesicle about ¼ as long as its segment; neck very short, with a small, round mouth.

Postpronotum and a small, anterolateral portion of adjacent median projection of scutum yellowish; with yellow pile. Scutum usually black over most of dorsum but sometimes with a broad, median, underlying yellow to orange stripe that nearly reaches or is continuous with posterior declivity, sometimes this coloration confined,

in varying intensities and extent, to posterior declivity; lateral margin of scutum often narrowly yellowish to above wing base, adjacent notopleuron mostly black; entire scutum lightly grayish pruinose dorsally, its anterior and especially lateral margins and posterior declivity densely pruinose, and, especially in anterior view, with a bright, silvery pruinose, ovoid to subtriangular spot just medial and posterior to postpronotal lobe, this spot reaching about ½ distance to base of wing; densely covered with short, recumbent, pale yellow pile that is longer laterally and posteromedially. Scutellum yellowish brown; densely covered with long, pale yellow setae. Postnotum concolorus with scutum, lightly pruinose. Pleuron densely grayish pruinose anteriorly, often mottled with traces of yellow posteriorly; anepisternal membrane pale brown; mesepimeral tuft pale yellow.

Wing membrane hyaline; veins pale yellow; base of costa; stem vein, and rest of fine setae on veins pale yellow; fringe of calypter and anal lobe pale yellow. Knob of halter yellow, stem mostly brown with pale yellow pile.

Foreleg yellow except tarsus black; midleg yellow except coxa, tip of basal 2 or 3 tarsomeres and apical tarsomeres black; hind leg mostly black except varying amounts of femur, basal ½ of tibia, basal ⅘ of hind basitarsus, and basal ½ of second hind tarsomere which are yellow; hind basitarsus slender, varying from 5.6 to 7.5 (av 6.4) times as long as broad. Calcipala short, bluntly rounded apically, reaching about ½ distance to pedisulcus; pedisulcus broad and deep but not conspicuous. Legs with mostly pale yellow setae but some of longer setae on posterior margin of hind tibia and tarsus brownish, and dark portions of tarsomeres with black setae.

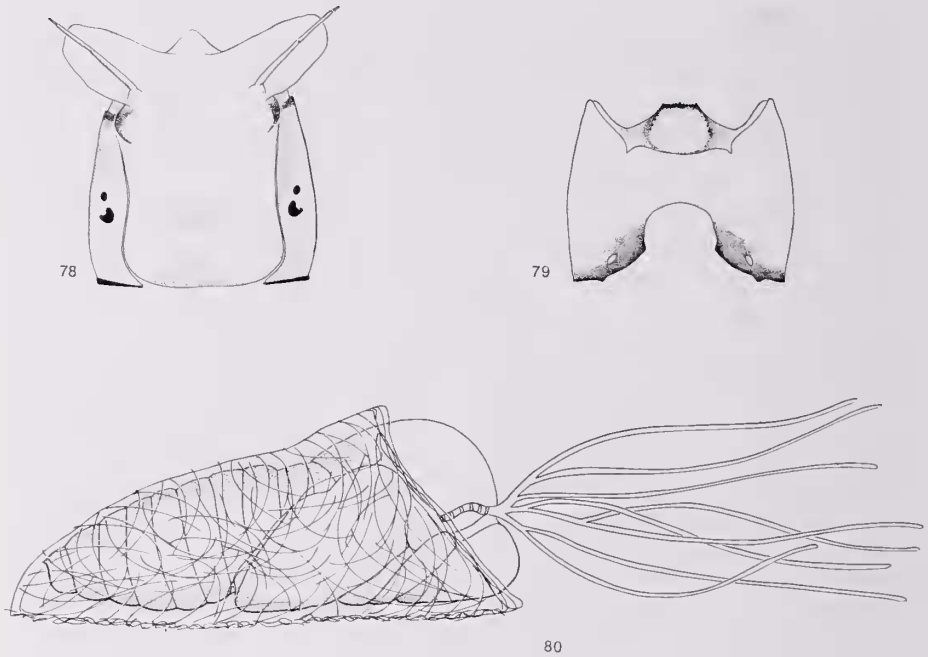
Abdomen, in alcohol preserved specimens, largely black dorsally, more yellow laterally and ventrally; basal scale black, with a fringe of long pale yellow pile; tergites 2 and 6 mostly yellow but each with a median black spot; tergites 3–5 and 8–9 black, tergite 7 with lateral ⅓ of each side yellow. In dried specimens, tergites black except most of tergites 2 and 6 densely grayish pruinose contrasting with other tergites, lateral marginal areas of tergites 7 and 8 similarly grayish pruinose; sparsely covered with short, black setae dorsally, but with longer pale yellow setae on lateral marginal areas; tergite 10 small, about 2.5 times as long as broad; sternite 1 moderately large, subtriangular, posterior margin rounded, sclerotized; sternite 2 membranous, sternites 3–8 subequal, subquadrate, pale yellowish, with pale yellow setae.

Terminalia as in Figure 76. Gonocoxite, at most, slightly longer than greatest width, subrectangular but slightly tapered distally, sparsely covered with pile on apical ½; distinctly longer than gonostylus. Gonostylus short and subrectangular, varying from slightly longer than greatest width at base to length and width being equal; apical margin, except for inner distal process, nearly straight or with outer distal corner rounded, and with a slight, medial concavity, and inner distal corner produced as a strong, but short, slender process bearing a single, small, nipple-like, terminal spine. Ventral plate of aedeagus, in ventral view, triangular, broadest at junction with basal arms, strongly tapered distally to an acute median point (Fig. 76a shows ventral plate with apex tilted inwardly (dorsally) so that it appears more rectangular), overall length equal to greatest width, length of body proper (from apex to junction with basal arms) ½, or slightly more, of greatest width; proximal margin between basal arms concave; basal arm short, tip slightly curved inwardly, heavily sclerotized, broadly rounded; in lateral view, without a ventral lip so ventral face is distinctly convex; distal margin between basal arms with a long, clear, membranous structure; dorsal

and ventral surfaces densely covered with short setae, those on ventral surface longest; median sclerite of aedeagus long, longer than body of ventral plate, stem very short, arms more than 4 times as long as stem, broadened distally, with a broadly rounded umbrellalike hood whose outer, distal margin is lightly but distinctly sclerotized except for opening of gonopore. Aedeagal membrane with a series of irregular clusters of minute setulae. Plate of endoparameral organ small, subquadrate to subtriangular, with a series of ridgelike cuticular thickenings; arm slender, sharply bent medially and then dorsally, bearing a series of numerous, poorly defined teeth, basal 3 or 4 teeth shorter, stouter and more distinctly defined.

PUPA. Length 2.4–3.6 (av 3.0) mm. Respiratory organ (Fig. 80) 1.4–2.3 (av 1.9) mm, filaments often broken but usually about ½–¾ as long as pupa; consisting of a short, slender base covered with minute spicules, and with 8 filaments arranged in 3 groups, all on short primary trunks, branching (2+1) + (1+2) + (2) (d-v), paired filaments of mediolateral group on a longer secondary petiole; filaments branching somewhat fanlike so that all are visible in lateral view, and are noticeably more slender than those of other species in this group; filaments pale yellow, with numerous fine, closely placed annulations. Integument of head and dorsum of thorax moderately covered with distinctly raised granules; antennal sheath of male reaching about ½ distance to hind margin of head; antennal sheath of female short of reaching hind margin of head by about ⅙ length of antenna; clypeus with 1 submedian seta just medial and ventral to base of antenna, frons with 3 short setae at extreme edge near level of first flagellomere of antenna. Dorsum of thorax usually with 4 dorsal and 2 more ventrolateral trichomes that are long, pale, and simple but often 1 dorsal trichome forked. Chaetotaxy of each lateral half of tergites as follows: tergite 1 with 2 short lateral setae; tergite 2 with 4 short, hooklike setae; tergites 3 and 4 with 4 stout, anteriorly directed spines along posterior margin; tergite 5 bare; tergites 6–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, sometimes those of 6 reduced in number; this row on each half of tergites 6–7 separated by a median gap but those of 8–9 complete; this spine row of tergite 7 continuous laterally with a few much smaller, comblike spinules; caudal spines very short, shorter than those of other species of this group; each situated on a faint convexity, straight, tips subparallel to slightly divergent. Chaetotaxy of each lateral half of sternites as follows: sternite 3 sometimes with 1 very small, submedian seta; sternite 4 with 2 small, slender, sublateral hooks; sternites 5–7 each with 2 longer, stouter hooks, those of 5 sublateral and closer together while those of 6–7 more separated but lateral hooks not lying in pleural membrane; sternites 8–9 bare. Cocoon slipper-shaped, tightly but rather coarsely woven so that there often are distinct thicker and thinner areas, anterior rim slightly thickened; in lateral view, anterior margin of cocoon nearly straight but variably slanting anteromedially; anteroventral corners of cocoon variably produced inwardly and, at times, they meet or nearly so to produce an anteroventral collarlike lip or rim; floor extended anteriorly about ½ length of cocoon. In material available for study cocoon unusually stiff and brittle and easily broken, seemingly more so than in any other species of this group.

LARVA. Length 4.2–4.8 (av 4.5) mm. Body color rather uniformly pale grayish white to pale yellowish white; intersegmental lines rather broad, slightly lighter than rest of abdomen. Head capsule (Figs. 78, 79) pale whitish yellow strongly contrasting with dark brown of postocciput, mandibular phragma and hypostoma, and with a



Figs. 78–80. *Simulium venator*. 78. Head capsule of larva, dorsal view. 79. Head capsule of larva, ventral view. 80. Cocoon and pupa, lateral view.

narrow brown band over small eye spots; dorsal head spots mostly not discernible, sometimes a faint brownish cast occupies posteromedian portion of frontoclypeal apotome, sometimes a vaguely H-shaped brownish area present between anteromedian and posteromedian spots, anterior ½ or more of frontoclypeal apotome whitish or colorless and transparent. Antenna slightly longer than stalk of labral fan, with a faint brownish tinge on upper ½ of segments, lower ½ transparent; proportions of segments (basal to apical) 10:20:19. Labral fan with about 36 primary rays. Hypostoma with median and outer lateral teeth nearly equal in height and only slightly longer than sublateral teeth; with 0–2 small, weak paralateral teeth; and 2–3 short, weak lateral serrations. Hypostomal cleft moderately deep, extended distinctly more than ½ distance to base of hypostoma. Hypostomal bridge slightly shorter than hypostoma. Mandible with 6 apical teeth 3 of which are weakly sclerotized, and with a relatively long, heavily sclerotized, toothlike process projecting dorsally at about 90° from near base of apical teeth; inner subapical ridge with 1 irregular apical serration and sometimes with a second smaller serration near its base. Maxillary palpus about 3.5 times as long as width at base. Lateral plate of proleg broad, lightly sclerotized, triangular shaped, extended nearly full length of apical segment; circlet of apical hooks in about 35 rows. Anal setulae present but minute and difficult to see, sparse and concentrated in area between anterodorsal and posteroventral arms of anal sclerite; anal papillae with 3 simple lobes, bases of outer and median lobe

narrowly separated, outer lobes strongly divergent from median lobe. Arms of anal sclerite broadly joined medially, anterodorsal arm moderately sclerotized with inner margin more heavily sclerotized, rather pointed apically, about 5/7 as long as posteroventral arm which is slender, tapered and heavily sclerotized. Posterior circlet of hooks consisting of 12–14 hooks in 75–80 rows. Ventral tubercles small, hardly noticeable.

REMARKS: This species is very similar to *mediovittatum* and, as can be seen from the listed synonymy, some authors considered the two species to be conspecific. However, the female of *venator* is easily separated from that of *mediovittatum* by the slender, pointed, ventral digitiform process of the anal lobe (Fig. 77). In *mediovittatum* the anal lobe is short, more quadrate, and has only a short pointed process (Fig. 43). The males can be separated by the features listed in the key. The larval description is based on a small number of mature larvae and so the integrity of the characters mentioned can not be substantiated.

The holotype female is mostly in good condition. However, the eyes are collapsed, and the left side of the thorax is somewhat obscured by the glue that attaches the specimen to a paper triangle on its pin. The abdomen was removed and mounted on a slide, probably by Dyar. Unfortunately, the abdomen was not dissected, but mounted whole and is flattened and rather badly damaged so the majority of the genital features are almost totally obscured, except for the genital fork which is clearly visible. However, if the slide is turned over and viewed from the underside, the ventral digitiform process of one of the anal lobes is faintly visible, enough to confirm that it is present, which is sufficient to distinguish it from *mediovittatum*. Of the four labels on the pin of the holotype, the uppermost label reads, "Reno Nevada July 7, 1916." The next lower label reads, "H Dyar coll." The next to bottom label simply says, "slide," and the bottom label is a red label that reads, "Type No. 28343 U.S.N.M." The type number is somewhat blotched but readable. The label on the slide with the female abdomen reads, "*Simulium venator* D. & S. Reno, Nev. July 7, 1916, H.G. Dyar." This is followed by the word "Paratype" which has a line through it, and along the bottom of the label is printed "Type No. 28343 U.S.N.M." Also, in the upper right hand corner is the "♀" symbol in pencil.

The holotype female of *beameri* is also glued to a paper triangle attached to a pin. The specimen is in reasonably good condition except that the eyes are collapsed, the thorax is rather greasy, and the left wing has a longitudinal tear just below the costa. The abdomen was removed and mounted on a slide, presumably by Stains or Knowlton. The upper label on the pin reads, "Lone Pine, Cal. VII-28-40 R.H. Beamer." This is followed by the next lower label which is small and bears only the number "36." The bottom label is somewhat aqua-blue-green in color and reads, "*Simulium beameri* n.sp. G.S.S. and G.F.K. Holotype."

When the holotype of *beameri* was borrowed, it was missing the genitalia and no slide or other preparation was found at UKaL. Fortunately, W. J. Hanson found slides with both the female and male terminalia, as well as three other slides bearing the missing terminalia of other species of black flies at Utah State University where Stains and Knowlton worked when *beameri* was described. Each of these slides has a conspicuous bright red star affixed to it. Unfortunately, the terminalia were mounted in a material that has crystallized (possibly Hoyers) and is difficult to see through.

The slide bearing the female genitalia of *beameri* allows just enough visibility to make out the digitiform process of the anal lobe which matches that of *venator*. The genital fork is also visible but is obscured by the crystallized mounting medium. The slide bearing the terminalia of the male allotype is in good condition and the parts are clearly visible. They agree in all respects with those of *venator* thus cementing the synonymy of *beameri* with *venator*. Two slides bearing male terminalia are also present in the USNM collection. One of these is labeled as a paratype of *beameri*, with a pencil notation that this specimen might be *notatum*. The non-paratype slide also is labeled as *beameri* and has a pencil notation that it equals *notatum*. These two specimens are *venator*. It is not likely they could be *notatum* since they are from different localities and have different collection dates, and the male of *notatum* from the type locality (or any other locality) is not known. The slides that Dr. Hanson located were sent to the USNM on permanent loan. However, they will be returned to UKaL to be housed with the rest of the holotype and allotype specimens.

SPECIMENS EXAMINED (total—138 males; 351 females; 41 pupae and pupal skins; 392 larvae): CALIFORNIA: *Inyo Co.*, May 18–September, (A) (includes paratypes of *beameri*). *Mono Co.*, July, (A). *San Bernardino Co.*, May 4–June, (A). *Tulare Co.*, July 28, (A). *Yolo Co.*, October, (A). IDAHO: *Bingham Co.*, July 26–September 8, (A). *Bonneville Co.*, July 18, (A). *Elmore Co.*, May 10–August 9, (A). *Gooding Co.*, September 9–23, (A). *Latah Co.*, June 16, (A). *Owyhee Co.*, August 4, (A). *Twinn Falls Co.*, August 6, (A). *Washington Co.*, September 2, (A). MONTANA: *Yellowstone Co.*, June 22, (A). NEVADA: *Clark Co.*, May 4, (A). *Elko Co.*, June 13–27, (A). *Humboldt Co.*, April 26–July 11, (A, P, L). *Lander Co.*, May 26–June 1, (A, P, L). *Lyon Co.*, August 4, (A). *Washoe Co.*, June 30–October 17, (A, P, L) (includes paratypes). OREGON: *Baker Co.*, September 2–December 13, (A). *Malheur Co.*, September 19, (A). UTAH: *Washington Co.*, March 3, (A). WASHINGTON: *Kittitas Co.*, July 22, (A). *Yakima Co.*, May 19–August 27, (A). WYOMING: *Yellowstone National Park*, July 21–August 4, (A). *Sublette Co.*, Pinedale, June 30–July 1, (A).

PREVIOUS RECORDS: U.S.: California, Idaho, Montana, Nevada, Oregon, Utah.

BIOLOGICAl NOTES: Little is known about the biology of *S. venator*. Like other species of the subgenus *Psilopelmia*, the immature stages usually occur on trailing vegetation in small to medium sized streams with clear and cool to relatively warm water. The females have been reported to feed on horses, and as reported by Knowlton (1935), ". . . this fly was usually found attacking the skin around the horse's nostrils and eyes or entering the ears." Twinn (1938) mentioned that he had seen two females that were "on horse with brain fever," collected in Lewiston, Utah, August 6, 1937. Some specimens in the USNM collection, from the state of Nevada, bear labels stating, "ex humans," and "off man and dog."

Simulium (Psilopelmia) labellei, new species
Figs. 81–92, 110–111, 114–115, 118, 120, 144–152

FEMALE. General body color black, densely grayish pruinose. Length: body, 1.9–2.9 (av 2.4) mm; wing, 2.3–2.6 (av 2.5) mm.

Head with frons moderately broad, at vertex about ⅔ wider than at narrowest point, less than ½ width of head, and slightly wider than long; sparsely covered with moderately long, erect whitish to pale yellowish pile. Clypeus concolorous or slightly

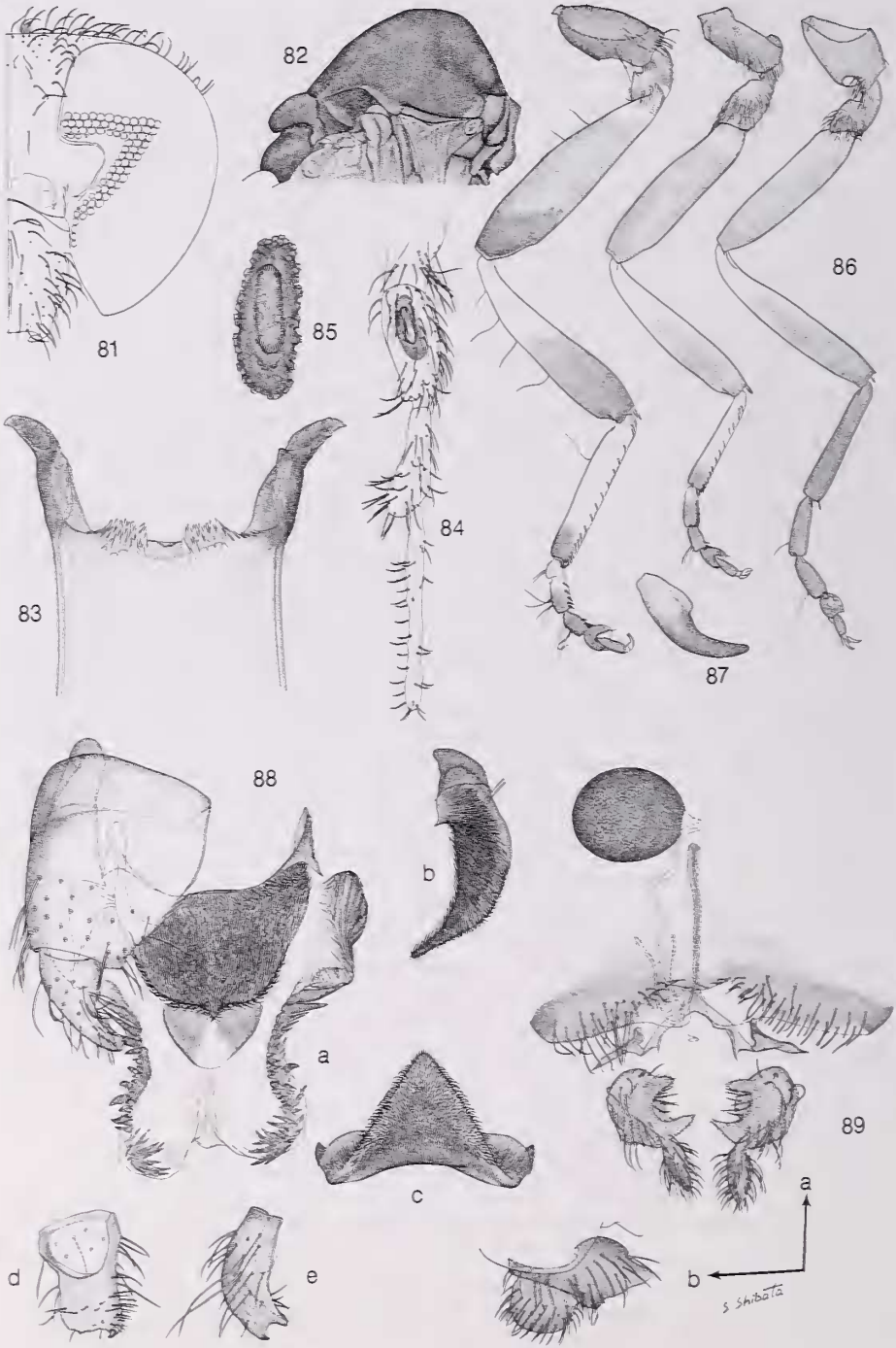
lighter than frons; length and width subequal; sparsely covered with moderately long, whitish to pale yellowish pile interspersed with a few dark setae. Occiput densely covered with long, whitish to pale yellowish pile; postocular setae fine, pale. Scape and pedicel of antenna bright yellow, contrasting with brownish black flagellum; pedicle and 1st flagellomere subequal in length, 1st flagellomere widest; fine pubescence pale yellowish with a few longer dark setae. Mandible with about 42 fine serrations. Blade of maxilla with 27–33 retrorse teeth. Palpus brownish black, distal 2 segments slightly lighter and more brownish than palpomere 3, with black setae; palpomere 5 about ⅓ longer than palpomere 3. Sensory vesicle relatively large, about ½ as long as its segment, proximally situated, its neck short, arising dorsomedially and extended vertically, with an enlarged, ovoid mouth. Median proximal space of cibarium shallow, broadly U-shaped, with 2 short convexities separated by a shallow median concavity, each convexity with about 17 small denticles that extend part way up rim of dorsolateral arm; dorsolateral arms moderately long, strongly divergent, moderately broad, heavily sclerotized.

Antepronotal and postpronotal lobes pale yellow to brown, distinctly paler than and usually strongly contrasting with scutum; covered with long, semi-erect to erect, whitish to pale yellow pile. Dorsum of scutum, in lateral view, strongly arched dorsally with high point at about anterior ⅖; anterior face steeply sloped, posterior face less steeply sloped. Scutum narrowly pale yellowish along lateral margins, and brown anteromedially between postpronotal lobes; anterolateral corner of scutum with a variably distinct, triangular shaped, grayish spot that extends less than ½ height of anterior face of scutum, remainder of scutum densely pruinose except for a moderately wide median strip, lateral margins and posterior declivity which are more lightly pruinose; scutum moderately covered with short, recumbent, pale yellow pile that is longer along lateral and posterior margins. Scutellum strongly triangular, brown, often paler yellowish medially, lighter than scutum, densely covered with long, pale yellow setae. Postnotum slightly darker brownish black than scutellum and more pruinose. Pleuron darker anteriorly, becoming paler medially and posteriorly, often mottled; anepisternal membrane yellowish gray; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins pale. Base of costa and stem vein with pale yellow pile, occasionally with a few dark setae; fringe of calypter and anal lobe pale yellow. Knob of halter white, stem brown with pale yellow pile.

Legs: Brown to brownish black, sometimes tinged with yellow. Dorsal surface of fore tibia yellow on about basal ¾, apex and ventral surface black; mid- and hind tibiae yellow on basal ¼ to ½, remainder dark. Fore tarsus entirely black, basal segment slender, cylindrical; basal segment of mid- and hind tarsi yellow except for a narrow apical ring; second tarsal segments of each leg yellow on basal ½ and dark on distal ½, remaining tarsal segments dark. Hind basitarsus about 6 times as long as broad. Claw simple, slender, short, evenly curved from base.

Abdominal ground color gray dorsally, slightly paler and more yellowish ventrally; basal scale (tergite 1) pale gray on about anterior ½ and dark brown to brownish black on posterior ½, with a fringe of long, whitish to pale yellow pile; tergites 2–6 small, subquadrate, matte brownish black to black, sparsely covered with short, coppery setae; tergite 7 larger, subquadrate but paler brown and densely pruinose; tergites 8–9 of normal shape, concolorous with tergite 7, with sparse pale coppery setae; pleural membrane of segments 2–7 each with a blackish, ventrally directed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band that occupies about anterior ½ of segment and extends ventrally about ½ height of pleural membrane, bands of segments 2 and 3 shorter. Sternites, except 8, broad but weakly sclerotized and nearly indistinguishable; posterior ½ of sternite 8 heavily sclerotized, brownish black to black, with fringelike row of long, dark setae near hind margin.

Terminalia as in Figures 89, 120. Anal lobe narrow dorsally, broadened ventrally at level of lower margin of cercus, at this point nearly as long as high; anterior margin strongly convex, tapered ventrally to a short, setose, digitiform process; posterior margin with a short but conspicuous process just below lower margin of cercus, margin then with a shallow concavity followed by a convexity and then another concavity which culminates in the ventral digitiform process, this process not long enough to cross with process of other anal lobe when in normal position; anal lobe moderately setose especially on posterior marginal area and ventrally. Cercus subquadrate, about as broad as long, hind margin broadly rounded, rather sparsely setose. Hypogynial valve short, not reaching anterior margin of cercus, subtriangular and rounded posteriorly, weakly sclerotized but medial margin slightly more heavily sclerotized; lightly setose basomedially; medial margins of valves diverging posteriorly. Stem of genital fork long, only slightly longer than arm, heavily sclerotized; in lateral view, strongly bowed with arms bent ventrally at almost a right angle to stem; arms strongly divergent; arm long, moderately broad basally, tapered and more slender medially, expanded distally into a subrectangular plate bearing a short, heavily sclerotized toothlike process on anteroventral margin, narrowly attached to segment 9. Spermatheca small, somewhat ovate, heavily sclerotized, without a distinct pattern.

MALE. General body color black, densely grayish pruinose. Length: body, 1.9–2.5 (av 2.2) mm; wing, 1.9–2.4 (av 2.2) mm.

Frons and clypeus densely pruinose, clypeus with erect coppery brown pile. Occiput with long, pale yellow setae. Antenna brownish black, scape and pedicel often paler yellowish brown, rarely yellow; 1st flagellomere slender, slightly longer than pedicel; pedicel distinctly wider than 1st flagellomere; fine pubescence pale yellow. Palpus brown, palpomere 3 more black; with yellowish brown to black pile; palpomere 5 about ⅔ longer than palpomere 3. Sensory vesicle globular, about ⅓ as long as its segment; neck distinct, enlarging to form a round mouth.

Postpronotum pale yellow to grayish brown, lighter than scutum; with pale yellow pile. Scutum black, anterior face with a variable grayish pruinose triangular spot just posteromedial to postpronotum, dorsum largely brownish gray pruinose becoming more gray and often less dense on anterolateral face and posterior declivity, lateral margins usually more lightly pruinose; moderately covered with short, recumbent, pale yellow pile that is slightly longer posteromedially. Scutellum brown, distinctly paler than scutum; densely covered with long, pale yellow setae. Postnotum concolorous with scutum. Pleuron black, often becoming slightly paler medially and posteriorly; anepisternal membrane yellowish gray; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins pale yellowish gray; base of costa and stem vein

←

Figs. 81–89. *Simulium labellei*. 81. Head of ♀. 82. Female thorax, lateral view. 83. Proximal end of ♀ cibarium showing armature. 84. Palpus of ♀. 85. Female sensory organ, enlarged. 86. Hind, mid-, and fore legs of ♀. 87. Claw of ♀. 88. Male terminalia. 89. Female terminalia.

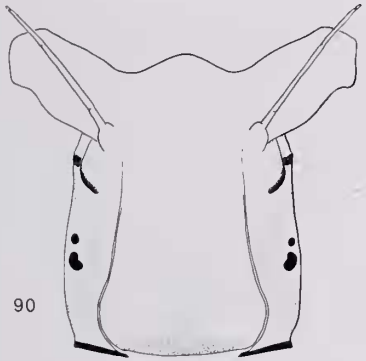
with pale yellow setae some of which may have dark bases; fringe of calypter and anal lobe pale yellow. Knob of halter white, stem brown with pale pile.

Fore leg entirely brownish black except for a slender yellowish streak along ventral surface of tibia. Midleg brownish black except about basal ¼ of tibia, basal ½ to ¾ of basal tarsomere and basal ½ of second tarsomere which are whitish to yellow. Hind leg brownish black except whitish to yellowish on about basal ½ of tibia, basal ¾ of basal tarsomere and basal ½ of second tarsomere; hind basitarsus slender, about 8 times as long as broad.

Abdomen matte brownish black dorsally, light gray ventrally; basal scale with a fringe of long pale yellow pile; tergites broad, nearly uniform in width, velvety in texture with paler hind margins; tergite 2 dark centrally, broadly yellowish gray laterally; tergite 6 densely gray pruinose, slightly less dense dorsomedially; hind margins of tergites 7 and 8 grayish pruinose; lateral margins of tergites 2–5 with long, pale yellow pile, tergites sparsely covered with short, pale yellow setae dorsally, these becoming black on tergites 6–9; tergite 10 small, rectangular, about twice as wide as long. Sternites 3–8 subquadrate, small but slightly increasing in size and degree of sclerotization posteriorly, about anterior ½ bare, posterior ½ sparsely covered with short, pale yellow setae.

Terminalia as in Figures 88, 118. Gonocoxite subquadrate, greatest width nearly twice greatest length, setose only on little more than distal ⅓. Gonostylus short, about ¼ longer than greatest width at base; outer apical margin variably rounded, sometimes only slightly produced and sometimes produced as a convexity as long or nearly as long as inner distal corner including single terminal spine, this results in a concavity of somewhat variable depth between them. Ventral plate of aedeagus broad; in dorsal view, somewhat triangular or spade-shaped with a short, ventral lip; in ventral view, broadest at junction with basal arms, tapered distally, apical margin narrow and nearly straight to faintly concave, but with a short, distinct median, ventrally directed, triangular process or lip, if slightly tilted then apex narrowly rounded; proximal margin between basal arms concave; basal arm short, slightly curved inwardly, end broadly rounded, with a short, subapical, posterolaterally directed process; median sclerite of aedeagus relatively long with short stem and long, deeply bifid arms that are broadly rounded distally. Basal plate of endoparameral organ short but broad, wrinkled basally, smooth distally and continuous with broad arm that twists and tapers distally to a more slender process bearing about 4–5 stronger and slightly more distinct basal teeth, and a more distal series of poorly defined teeth; apices of arms joined anteromedially in a broad V-shape, and are continuous with a moderately sclerotized, rodlike fold of aedeagal membrane, this rodlike structure directed anteriorly (internally), but is shorter than that in *robynae*. Aedeagal membrane beset with scattered, minute, mostly single spiniform or rodlike thickenings but with some comblike ridges.

PUPA. Length 2.4–3.0 (av 2.7) mm. Thorax, in lateral view, distinctly separated from head, its anterior face nearly vertical and conspicuously arched well above level of top of head (Fig. 92). Respiratory organ with 8 filaments; 1.9–3.0 (av 2.4) mm long, when complete often as long as pupa, but more frequently broken and shorter than pupa. Branching pattern somewhat variable but most often as follows: base short, rather slender, with very minute spicules; base branches into an outer lateral trunk with 2 filaments, and an inner more dorsal trunk that in turn divides into a



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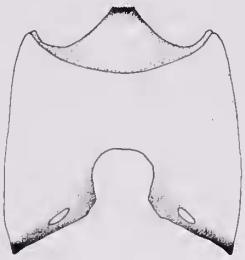

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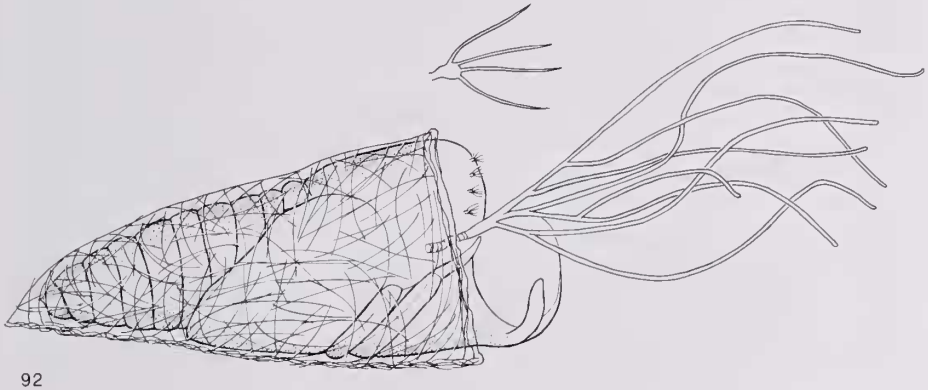

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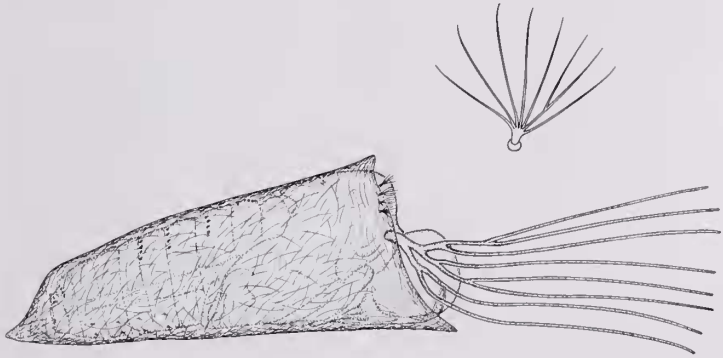

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Figs. 90–93. *Simulium labellei*. 90. Head capsule of larva, dorsal view. 91. Head capsule of larva, ventral view. 92. Cocoon and pupa, lateral view, with enlarged view of a thoracic trichome. *Simulium robynae*. 93. Cocoon and pupa, lateral view, with enlarged view of a thoracic trichome.

dorsomedial trunk branching 2+1 (dorsal-ventral) and a medioventral trunk branching 1+2; filaments slender, whitish to pale yellowish, with fine, shallow annulations. Integument of head and dorsum of thorax much as in *robynae* with faintly raised granules but which are more numerous and closely placed on the head, and less so on thorax so that thorax appears more glossy; antennal sheath of male reaching about ½ distance to hind margin of head; antennal sheath of female not reaching hind margin of head by about length of 2 antennomeres; clypeus with a pair of pale setae medial and ventral to bases of antennae, other setae not visible on specimens at hand. Anterolateral face of thorax with a series of 4 tuftlike trichomes, each with a short stout base that gives rise to 4–12 or more slender, pale branches, often arranged fanlike, that may be long enough to overlap those adjacent to it; a similar trichome is situated just posterior to base of respiratory organ and another just anterior to anteroventral angle of wing sheath; dorsal surface of thorax, above level of respiratory organ, usually with 2 fanlike and 1–3 long, simple trichomes on each side. Chaetotaxy of each lateral half of abdominal tergites as follows: tergite 1 with 1 long, sublateral seta; tergite 2 with a posterior row of 4 small, hooklike setae sublaterally and with 1 or 2 similar setae at edge of tergite; tergites 3 and 4 each with 4 anteriorly directed spines along posterior margin and with 1 seta just anterior to this row of spines and 2 or 3 similar setae along lateral edge of tergite; tergites 5–6 essentially bare; tergites 7–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, those of tergites 7 and 9 with broad gap medially, but that of tergite 8 complete or with a narrow medial gap; caudal spines short, each situated on a slightly swollen convexity, these spines straight, tips slightly convergent. Chaetotaxy of each lateral half of sternites as follows: sternite 3 with 1 lateral seta; sternite 4 with 1 small, slender, submedian hook and 1 medial and 1 lateral seta; sternites 5–7 each with 4 longer, stouter hooks, those of 5 submedian and close together, lateral hooks of sternites 6–7 placed near lateral edge of sternite; sternites 8–9 bare. Cocoon yellowish gray, slipper-shaped with a low profile, densely woven, anterior edge not thickened nor reinforced, or only weakly so, and thus often somewhat irregular; in lateral view, anterior margin of cocoon nearly straight, only slightly slanting anteroventrally; floor often extended full length of cocoon, but fragile and easily damaged.

LARVA. Length 4.2–5.2 (av 4.7) mm. Body color brownish yellow, slightly more brownish posterodorsally, and more whitish ventrally; intersegmental lines narrow, slightly darker than rest of abdomen; abdomen widest at junction of segments 6 and 7 then rather strongly tapered to posterior circlet of hooks so that abdomen is somewhat bluntly pointed posteriorly. Head capsule (Figs. 90, 91) pale yellow to brownish yellow, only postocciput, mandibular phragma and eye spots dark brown to black; posterior margin of frontoclypeal apotome sometimes with a small, median, brown triangular spot, and upper margins of postgenae above eye spots sometimes brownish, otherwise head spots, at most, faintly distinguishable; frontoclypeal apotome transparent whitish anterior to level of mandibular phragma except anterior margin narrowly brownish. Antenna slender, almost transparent whitish and often difficult to see clearly, slightly but distinctly longer than stalk of labral fan; proportions of segments (basal to apical) 7:9:9. Labral fan with about 75–82 very fine primary rays. Labrum clothed with short erect setae. Hypostoma with distal margin slightly concave, median and outer lateral teeth nearly equal in height, sublateral teeth very small but distinct, paralateral teeth represented by 2 slight convexities, and with 3

lateral serrations that also are weak but better developed than paralateral teeth; with 5 subequal but very slender, pale hypostomal setae on each side and 1 smaller sublateral setae near hind margin, these setae difficult to see except under high magnification. Hypostomal cleft somewhat U-shaped, anterior margin difficult to discern, shallow; Hypostomal cleft, hypostomal bridge, and hypostoma all subequal in length. Mandible with 6 apical teeth, dorsal process arising near base of these teeth heavily sclerotized, rather broad and rounded distally in one view, and slender and pointed in another; with about 9 combteeth; inner subapical ridge with 1 small, fine serration. Maxillary palpus nearly parallel sided, tapered only slightly, about 4 times as long as width at base. Lateral plate of proleg relatively broad, irregular but somewhat triangular in shape, extended nearly full length of apical segment, lightly sclerotized and often difficult to see; circlet of apical hooks in about 34 rows. Anal setulae apparently absent; anal papillae consisting of 3 simple lobes whose bases are set close together, lateral lobes rather straight, not strongly divergent from median lobe, all 3 lobes often projecting anteriorly more so than in most other species. Anterodorsal arm of anal sclerite slender, weakly sclerotized, subequal in length to posteroventral arm which also is slender but heavily sclerotized, arms broadly but weakly joined medially. Posterior circlet of hooks narrower than in most other species, consisting of about 20–24 minute hooks in about 110–116 slender rows. Ventral tubercles present but small and inconspicuous.

HOLOTYPE. Female, Presidio, *Presidio Co.,* TEXAS, January 12, 1949 (collector unknown).

PARATYPES. 10 ♂♂, 11 ♀♀, 2 pupae, 3 larvae, same data as holotype; 1 ♀, 1 ♂, same data except January 26, 1944, J. H. Russell; 1 ♀, 29 mi south Marathon, *Brewster Co.,* TEXAS, April 12, 1949, Michener and Beamer; 3 ♂♂, 3 ♀♀, Del Rio, *Val Verde Co.,* TEXAS, December 15, 1963, R. B. Eads, light trap. 1 ♂, same data except December 20, 1963. 5 ♂♂, 2 ♀♀, same data except February 1964. 1 ♀, MEXICO (no other data), January 13, 1940. Holotype and paratypes deposited in the U.S. National Museum of Natural History, Washington, D.C.

DEDICATION. This unusual species is dedicated to Robert Labelle, of Toronto, Ontario, Canada, who is a very unusual and distinctive man in the most positive sense, and who has been and remains a very choice friend.

REMARKS. Structurally, this species is similar to *S. robynae* n. sp. in the highly arched dorsum of the thorax and the terminalia of both sexes. However, adults of *labellei* are almost entirely black and somewhat larger than *robynae* whose adults are predominantly orange and smaller. The two species can be separated by the characters given in the keys.

The noticeable highly arched thorax of both sexes, and the similar form of the pupal thorax with the series of 4 stout, multibranched trichomes on each anterolateral margin immediately separates both of these species from all other North American species. It must be noted here that the pupal and larval descriptions were based on just a few specimens from the type locality, Presidio, Texas. All of these specimens were dissected for the descriptions and illustrations and therefore the descriptions may need some revision when additional material is available for study.

BIOLOGICAL NOTES. Almost nothing is known about the biology of this interesting species. Most of the available specimens were collected in light traps, and several females have blood in the abdomen which indicates that they probably feed

on horses or cattle, or both. All available specimens were collected during the winter months of December, January and February, with only one collection made in April. However, this may reflect the activities of the collectors, not the seasonal distribution of the species. This species and the following species both occur in Del Rio, Texas, and probably live in the same or similar habitats, and have similar habits.

Simulium (Psilopelmia) robynae, new species
Figs. 93–109, 112–113, 116–117, 119, 121

Simulium ochraceum Walker, Cockerell, 1897:100 (on horse) (misidentification).
Simulium notatum Adams, Malloch, 1914:32 (♀, ♂, description, key, catalog, plate 5, fig. 6) (♀ only; ♂ identity unknown; misidentification); Dyar and Shannon, 1927: 36 (♀, ♂, description, key, figs. 88–89) (♀ only; ♂ identity unknown; misidentification).

FEMALE. General body color varying from orange, orange with a blackish tinge to black with an orange tinge, and grayish pruinose. Length: body, 1.5–2.1 (av 1.8) mm; wing, 1.9–2.1 (av 2.0) mm.

Head black. Frons moderately broad, at vertex slightly less than ½ as wide as at narrowest point, less than ½ width of head, and length and greatest width nearly equal; moderately covered with relatively long, decumbent, whitish to faintly yellowish pile. Clypeus concolorous with or more yellowish brown than frons; length and width subequal; moderately covered with relatively long, whitish to faintly yellowish pile. Occiput densely covered with long, whitish to faintly yellowish pile; postocular setae pale. Antenna with scape, pedicel and basal ½ or more of 1st flagellomere yellow, rest of flagellum varying from entirely (or nearly so) yellow, to more yellowish brown to black; pedicle and 1st flagellomere nearly equal in both length and width; fine pubescence pale yellow. Mandible with about 30 minute serrations on inner margin and about 3–10 weak, poorly defined serrations on outer margin. Blade of maxilla with 22–27 retrorse teeth. Palpus pale yellowish brown to black, distal 2 segments slightly lighter and more yellowish than palpomere 3; with pale yellow setae admixed with some dark setae; palpomeres somewhat variable in length, palpomere 5 varying from twice as long to only ⅕ longer than palpomere 3. Sensory vesicle slightly more than ½ as long as its segment, proximally situated, its neck short, arising anterodorsally and extended vertically, with an enlarged ovoid mouth. Median proximal space of cibarium shallow, broadly U-shaped, with a central concavity between 2 low, sublateral lobes each bearing about 6–9 weak, ill defined denticles; dorsolateral arm short, rather broad, outwardly curved, and moderately sclerotized.

Thorax ranging in color from orange, to brownish orange to black; antepronotum, postpronotum and scutum concolorous, each covered with long, pale yellow pile. Scutum strongly arched; in lateral view, anterior face nearly vertical, highest point situated just anterior to midlength of scutum, posterior portion less strongly sloping; scutum, in anterior view, rather uniformly pruinose except for a sublateral stripe on

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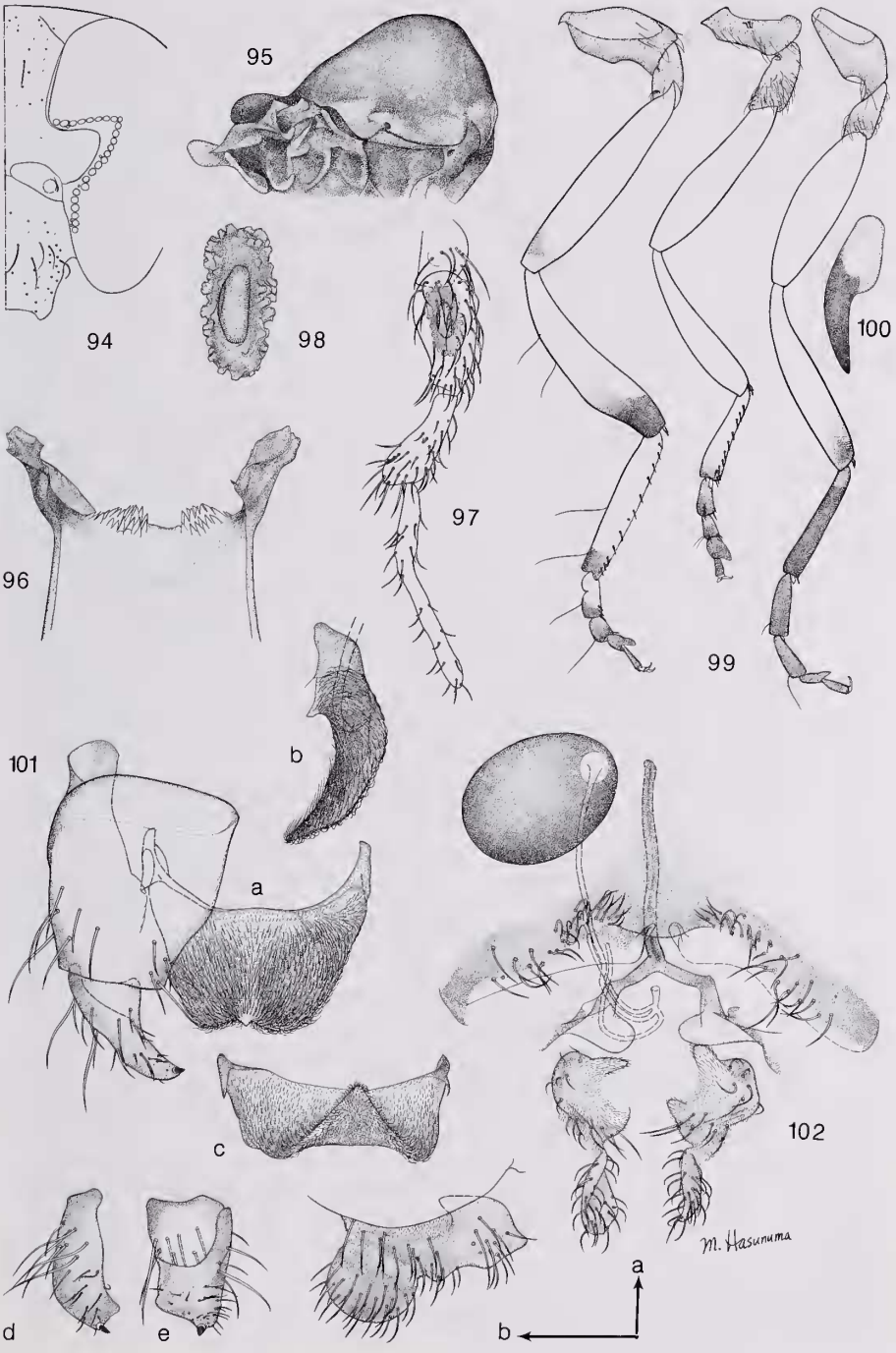
Figs. 94–102. *Simulium robynae*. 94. Head of ♀. 95. Female thorax, lateral view. 96. Proximal end of ♀ cibarium showing armature. 97. Palpus of ♀. 98. Female sensory organ, enlarged. 99. Hind, mid-, and fore legs of ♀. 100. Claw of ♀. 101. Male terminalia. 102. Female terminalia.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each side and extreme lateral margins which are more grayish pruinose, lateral margins slightly paler in color; anterolateral corner of scutum with a small, variably distinct triangular, grayish spot; scutum rather densely covered with short, recumbent, pale yellow pile which is longer along anterior and lateral margins and still longer posteromedially. Scutellum varying from yellow to black, when yellow then paler than scutum; densely covered with long, pale yellow setae. Postnotum orange brown to black, moderately grayish pruinose. Pleuron concolorous with scutum, usually uniform in color and pruinosity, sometimes slightly paler and mottled medially and posteriorly, anterior margin nearly vertical, curved posteriorly at katepisternum; anepisternal membrane slightly more pale; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins yellowish; base of costa and stem vein with pale yellow pile; fringe of calypter and anal lobe pale yellow. Halter yellow, stem sometimes tinged with brown, with pale pile.

Legs: Foreleg yellow except for tarsus which is black. Midleg yellow except for distal 2 tarsomeres which are black. Hind leg yellow except for apices of tibia, basitarsus, second and sometimes third tarsomeres, and distal 2 tarsomeres which are black; in black specimens, black of legs may be somewhat more extensive; hind basitarsus slender but varying from 4–7 times as long as broad; calcipala short, not reaching pedisulcus; pedisulcus small, moderately deep. Claw short, evenly curved from base, simple.

Ground color of abdomen in all but black form brownish yellow, becoming paler yellow ventrally; abdomen brownish black in black form. Basal scale (tergite 1) yellow, with a fringe of long, pale yellow pile; tergites 2–6 small, subquadrate, matte brownish black, tergites 7–9 broader, paler grayish yellow to brownish; pleural membrane of segments 3–6 each with a darker grayish mark that extends ventrally about ¼–⅓ distance to sternites; sternites lightly sclerotized, pale yellow, barely discernible, sparsely setose.

Terminalia as in Figures 102, 121. Anal lobe narrow dorsally, broadened ventrally at level of ventral margin of cercus where it is produced posteriorly as a slight but distinct convexity and is continuous ventrally with a distinct concavity and a short, moderately broad, digitiform process; anterior margin of anal lobe below tergite 9 strongly, and broadly convex then tapered to digitiform process; greatest length about equal to height from ventral tip of digitiform process to lower margin of cercus; posterior margin not produced beneath cercus; moderately setose. Cercus subquadrate, slightly higher than long, hind margin strongly rounded, moderately setose. Hypogynial valve short, in normal position not reaching digitiform process of anal lobe; valve subtriangular, narrowly rounded to slightly pointed posteriorly, medial margin lightly sclerotized, convex, narrowly separated from one of other side, sparsely setose on basal ½. Stem of genital fork long, heavily sclerotized, about ⅔ longer than arms; in lateral view, bent ventrally at nearly a right angle at point of origin of arms; arms moderately long, diverging in a broad V-shape, curved posteriorly at about ½ length of arm, expanded distally into a subrectangular plate with a short, sclerotized toothlike process directed dorsally to anterodorsally on anteroventral margin, arm narrowly attached to segment 9. Spermatheca small, elongate, heavily sclerotized, with a loose reticulate pattern.

MALE. General body color black, lightly grayish pruinose. Length: body, 1.4–2.0. (av 1.7) mm; wing, 1.3–1.7 (av 1.5) mm.

Frons and clypeus lightly to moderately gray pruinose; clypeus with long, pale yellow pile. Occiput with long, pale yellow setae. Antenna brownish yellow, scape and pedicel paler yellow; pedicel and first flagellomere nearly equal in length; fine pubescence pale yellow. Palpus black, palpomeres 4–5 more gray, with pale yellow and brownish pile; palpomere 5 about ⅔ longer than palpomere 3. Sensory vesicle about ⅓ as long as its segment; neck short, enlarged to form a round mouth.

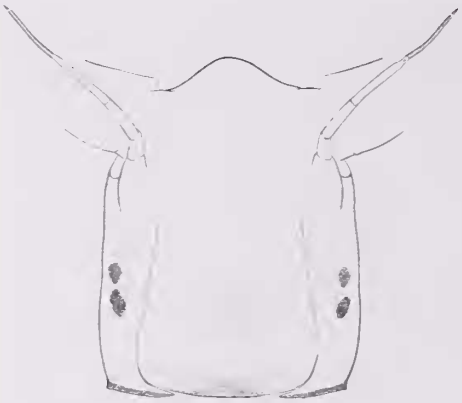
Antepronotal lobe, postpronotal lobe and adjacent anteromedian portion of scutum, plus lateral margin of scutum yellow overlain with a grayish pruinosity, antepronotal and postpronotal lobes with long, yellow pile; remainder of scutum variably orange black to black with a gray pruinosity, and moderately covered with short, recumbent, yellow pile that is longer laterally and posteromedially. Scutellum yellowish brown, paler than scutum; densely covered with long, yellow setae. Postnotum concolorous with scutum. Pleuron black anteriorly, becoming slightly paler medially and posteriorly, and sometimes mottled; anepisternal membrane brownish black; mesepimeral tuft small, pale yellow.

Wing membrane hyaline; veins pale yellow; base of costa and stem vein with pale yellow pile; fringe of calypter and anal lobe pale yellow. Knob of halter bright yellow, stem brown with pale yellow pile.

Foreleg yellow except dorsal surface of tibia which is variably browned, and tarsus which is black. Midleg largely yellow except coxa and dorsal surface of femur which are variably browned, and apex of first 2 tarsomeres and all remaining tarsomeres which are brown to black. Hind leg black except basal ¼–⅓ of femur, basal ½ of tibia, and all but apex of basitarsus and basal ½ of 2nd tarsomere yellow; hind basitarsus about 4 times as long as broad. Claw small.

Abdomen largely black but pleural membrane yellowish gray; basal scale with fringe of long pale yellow pile. Tergites matte black, hind margins narrowly yellow to gray, that of tergite 7 more broadly gray, moderately covered with mostly pale yellow setae; tergite 10 small, rectangular, about ⅖ wider than long; sternites 3, 4 and basal ⅔ of sternite 5 yellow, posterior ⅓ of sternite 5, and all of sternites 6–8 black; with mostly pale yellow setae.

Terminalia as in Figures 101, 119. Gonocoxite subquadrate, slightly longer than greatest width, sparsely setose on all but basal ⅖. Gonostylus short, about ⅖ longer than greatest width at base; apical margin with inner distal angle produced as a slender, digitiform process that extends well beyond outer distal angle, with 1 tiny terminal spine, moderately setose. Ventral plate of aedeagus, in ventral view, broadest at junction with basal arms; in one view, tapered distally to a slender, nipplelike, median point that, in another view, is set off by a slight concavity on either side, but distal margin never straight or only faintly concave; marginal area between basal arms concave; basal arm short, pointed apically, moderately sclerotized, straight to faintly bowed outwardly; median sclerite of aedeagus with stem short, arms distinctly longer and deeply separated, broadly rounded distally. Basal plate of endoparameral organ broad, subquadrate, with corrugations; arm moderately broad, bent in a U-shape, bearing about 20 irregular, poorly defined teeth of which 2–4 are longer and better defined; between and joining apex of each arm is a somewhat sclerotized, rodlike thickening of the aedeagal membrane that is directed internally at about a right angle to apices of arms; this thickening lies just dorsal to opening of gonopore and possibly serves as a support to the dorsal surface of the aedeagal membrane. Aedeagal mem-



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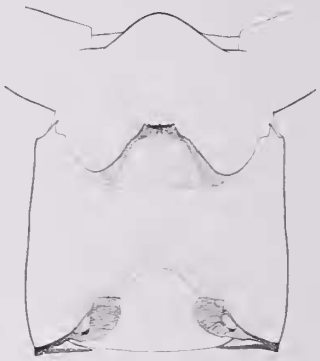

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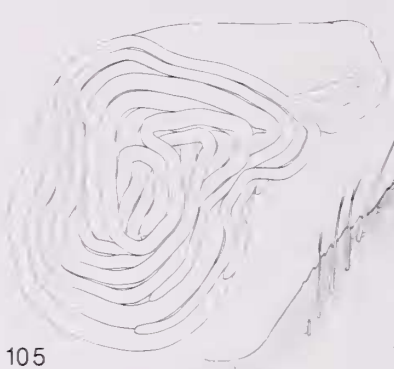

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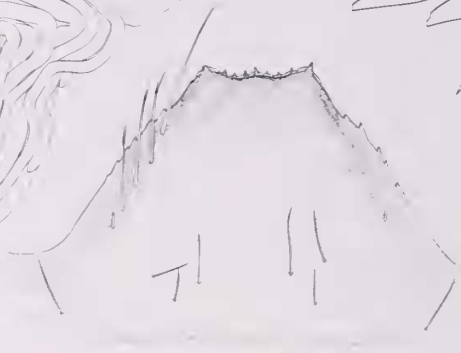

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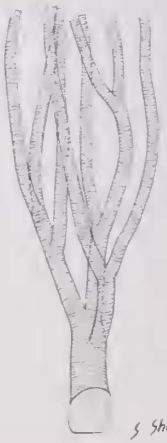

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brane beset with numerous minute, closely placed, comblike ridges composed of 1 to about 8 rodlike thickenings.

PUPA. Length 2.8–3.00 (av 2.9) mm. Thorax of pupa, in lateral view, distinctly separated from head, anterior face of thorax nearly vertical and projected dorsally well above level of top of head (Figs. 93, 108). Respiratory organ (Figs. 93, 109) with 8 filaments; varying from 1.3–1.6 (av 1.5) mm long (those of the specimens available at least partially broken and greatest length may be somewhat longer than indicated here); branching pattern somewhat variable as to position of 3 main groups of filaments as follows: base of respiratory organ short, slender, covered with minute spicules; base usually giving rise to a dorsal branch with a short, stout petiole that divides into a dorsomedial branch with 3 filaments branching 2+1 (dorsal-ventral), and a more ventromedial branch with 3 filaments branching 1+2 (d-v); and a more ventrolateral branch on a long, slender petiole that divides into 2 filaments; sometimes this latter branch is dorsal in position and the other 2 main groups of filaments take a more ventral position; filaments pale yellow, with numerous narrow, irregular annulations. Integument of head and thorax with numerous, tiny, closely placed granules that are only faintly raised and have a texture similar to that found on a football made of pigskin; antennal sheath of male reaching about ½ distance to hind margin of head; antennal sheath of female short of reaching hind margin of head by about length of 2 antennomeres; clypeus with 2 median setae at about level of base of palpus. Thorax just posterior and dorsal to respiratory organ with row of 4 rather stout, tuftlike trichomes each with about 5–12 branches, and with about 2–3 more posterolateral dorsal trichomes that are long and simple or bifurcate. Chaetotaxy of each lateral half of tergites as follows: tergite 1 with 1 anterolateral and 1 posterolateral seta; tergite 2 with a posterior, submedian row of 3–4 short setae, 2 slightly more anterolateral setae, and 2 more posterior setae along lateral margin; tergites 3 and 4 each with 4 stout, anteriorly directed spines along posterior margin, and 1 more anterior submedian seta and 1 lateral seta; tergites 5–6 essentially bare except for 1 or 2 minute scattered setae, tergite 6 sometimes with a vestige of 1–3 tiny spinules at extreme anterolateral margin; tergites 7–9 each with a row of short, fine, posteriorly directed spinules near anterior margin, those of tergite 7 with a wide median gap, those of tergites 8–9 complete or with a narrow gap medially; caudal spines tiny, straight, tips subparallel to slightly convergent, each situated on a slightly swollen convexity. Chaetotaxy of each lateral half of sternites as follows: sternite 3 with 0–1 very small, anterolateral seta; sternite 4 with 1 small, slender lateral hook; sternite 5 with 2 larger, closely situated lateral hooks; sternites 6–7 each with 2 longer, rather slender, broadly separated hooks, lateralmost hook lying in lateral margin of sternite, sternites 8–9 bare. Cocoon slipper-shaped, yellowish gray, tightly woven but rather transparent; in lateral view, with a low profile, anterolateral margin of cocoon nearly vertical, anteroventral corner projecting only slightly in front of side; floor extended about ⅘ length of cocoon.

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Figs. 103–109. *Simulium robynae*. 103. Head capsule of larva, dorsal view. 104. Head capsule of larva, ventral view. 105. Respiratory histoblast of mature larva. 106. Tip of mandible of larva. 107. Hypostoma of larva. 108. Cocoon and pupa, lateral view (not showing thoracic trichoms). 109. Basal portion of respiratory organ of pupa.

LARVA. Length 3.9–4.6 (av 4.3) mm. Body color pale white to yellowish white, segments 6–8 with a touch of reddish brown dorsally; intersegmental lines rather broad, concolorous with rest of abdomen; abdomen noticeably slender on segments 1–4, segment 5 conspicuously widened, remaining segments tapered posteriorly; with a pair of short, posteroventral tubercles. Head capsule (Figs. 103, 104) pale yellowish white, frontoclypeal apotome paler anteriorly and almost transparent, head spots very faintly detectable, hind margin narrowly pale brownish. Postocciput and mandibular phragma contrastingly dark brown, cervical sclerites seemingly absent. Gena, just dorsal to eye spots and just below ecdysial line, with a slender brownish streak; eye spots small, black, sometimes absent. Antenna pale yellowish white, distinctly longer than stalk of labral fan by about ½ or more length of distal antennomere; proportions of antennomeres somewhat variable but about 11:13:16 (basal to apical). Labral fan with about 60–64 primary rays. Hypostoma as in Figure 107; apical margin nearly straight to faintly concave, medial tooth short, about as long as outer lateral teeth; outer lateral teeth short but only slightly longer than sublateral teeth which are very small; paralateral teeth absent; with 2–3 weakly developed, lateral serrations; with 4–5 fine, pale, hypostomal setae. Hypostomal cleft broadly rounded, apex slightly pointed; moderately deep, extended about ⅔ distance to base of hypostoma. Hypostomal bridge usually slightly shorter than hypostoma, more rarely subequal in length. Mandible with 3 apical teeth with distalmost largest, and 8–11 preapical teeth; outer distal margin with a small, broadly rounded, subconical process that is about as long as greatest width at base; inner subapical ridge with 1 small, distal serration that is much larger than a very minute, proximal serration situated close to base of distal serration, sometimes proximal serration absent. Maxillary palpus slender, about 4 times as long as width at base. Lateral plate of proleg broad, irregularly subquadrate, lightly sclerotized and indistinct, extended about ¾ length of apical segment; circlet of apical hooks in about 28–30 rows. Anal setulae absent; anal papillae with 3 simple lobes that are rather sharply pointed apically, and narrowly separated basally. Anterodorsal arm of anal sclerite about ⅝ as long as posteroventral arm, area between arms heavily sclerotized as a subrectangular block, arm with heavily sclerotized medial ridge and irregular and less sclerotized margins; posteroventral arm heavily sclerotized, slender and distinct. Posterior circlet of hooks consisting of 12–15 hooks in 85–90 rows.

HOLOTYPE. Female, 10 miles west of Del Rio, *Val Verde Co.*, TEXAS, Oct. 13, 1953, H. M. Brundrette.

PARATYPES. 1 ♂, 38 ♀♀, same data as holotype. 3 pupae, 1 pupal pelt, Rio Grande, Big Bend National Park, *Brewster Co.*, TEXAS, March 16, 1954, Coleman. 1 pupa, 4 pupal pelts, 14 larvae, same data. 2 ♂♂ (poor condition), 2 pupal pelts, 16 larvae, same data. 1 ♂, 1 ♀ dissected from pupae, 1 pupa, 2 larvae, same data except March 17, 1954. 1 ♀, reared, Terlingua creek, Big Bend National Park, *Brewster Co.*, TEXAS,

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Figs. 110–117. *Simulium labellei.* 110. Female head and thorax, lateral view. 111. Male head and thorax, lateral view. *Simulium robynae.* 112. Female head and thorax, lateral view. 113. Male head and thorax, lateral view. *Simulium labellei.* 114. Female thorax, dorsal view. 115. Male thorax, dorsal view. *Simulium robynae.* 116. Female thorax, dorsal view. 117. Male thorax, dorsal view.

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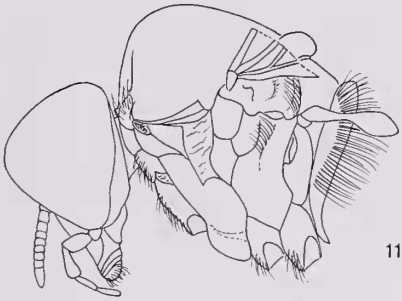

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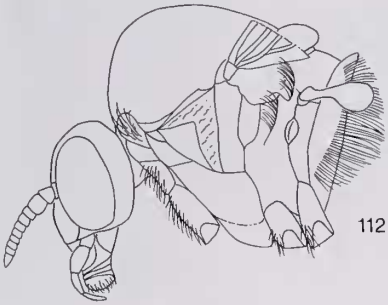

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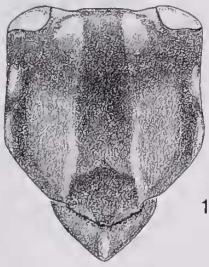

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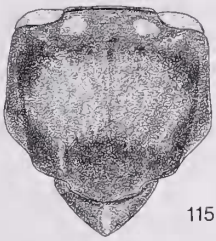

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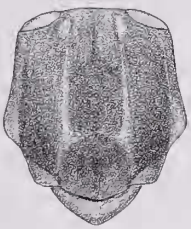

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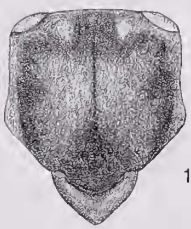

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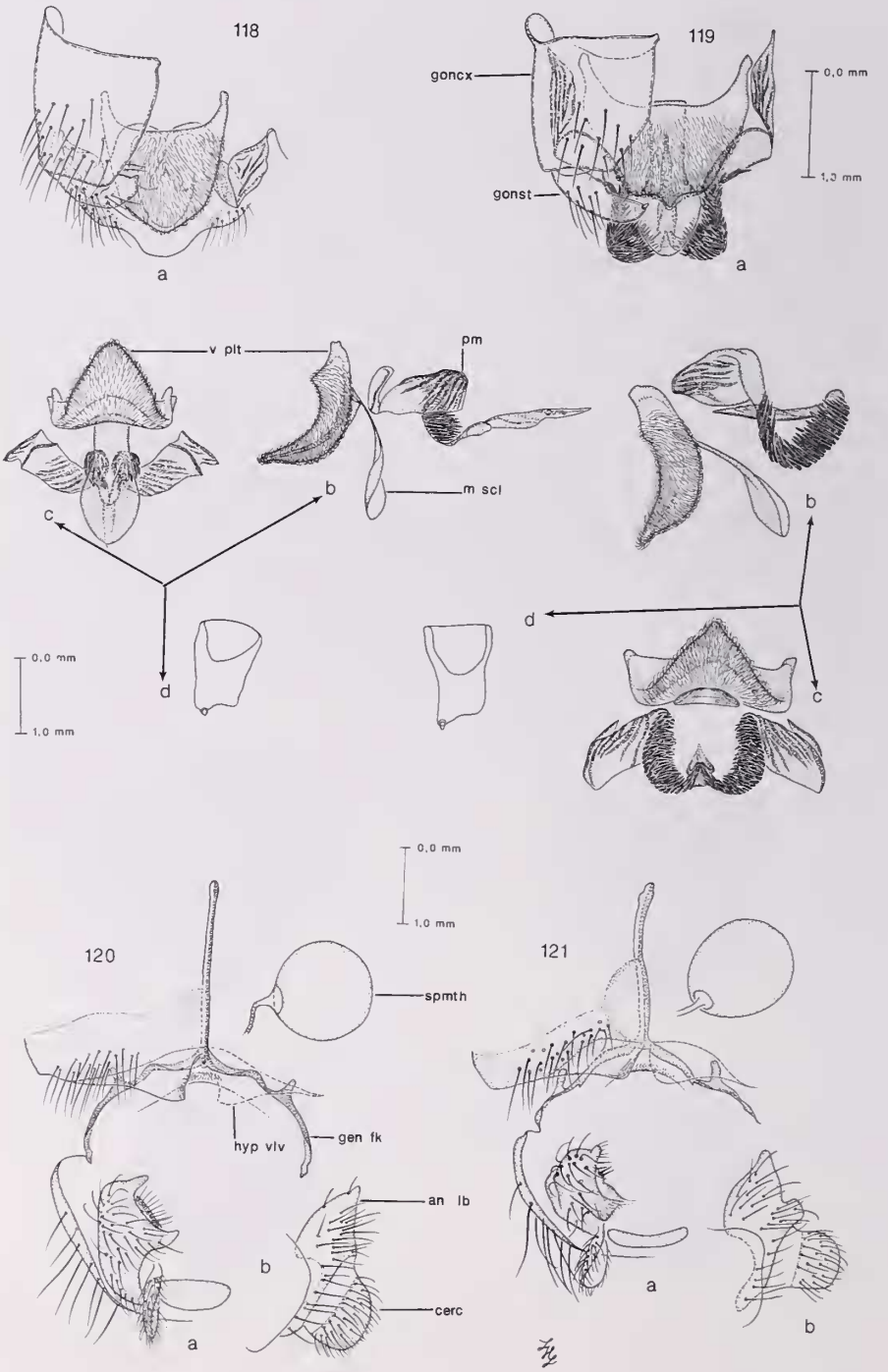
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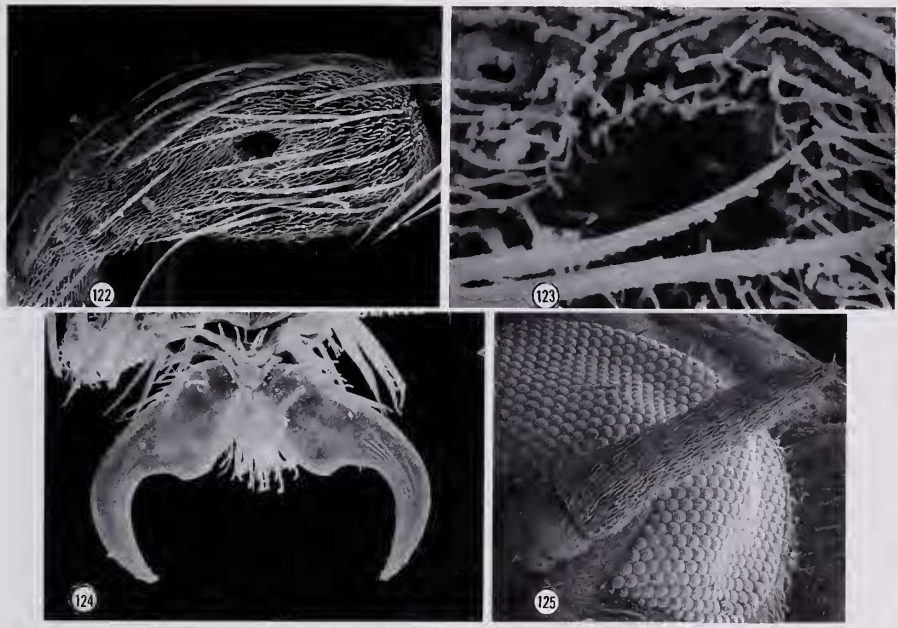

Figs. 122–125. SEM Micrographs. *Simulium griseum,* female. 122. Third palpomere showing mouth of sensory organ (vesicle). 123. Enlargement of mouth of sensory organ. 124. Claws. 125. Portion of head showing eye and antenna.

March 17, 1954, Coleman. 5 pupae, 18 larvae, Grassy Banks picnic area on Rio Grande, approximately 9.5 miles west of Lajitas on Hwy. 170, *Presidio Co.,* TEXAS, May 8, 1991, B. V. Peterson. 15 ♀♀, J. Ramirez Farm, *Presidio Co.,* TEXAS, September 10, 1972, USDA collection, on horse. 3 ♀♀, Davenport Ranch, *Terrell Co.,* TEXAS, June 10, 1965, from ear of jackrabbit. 8 ♂♂, 11 ♀♀, Del Rio, *Val Verde Co.,* TEXAS, September 24, 1963, R. B. Eads, light trap. 17 ♂♂, 11 ♀♀, same data except October 4, 1963. 20 ♂♂, 16 ♀♀, same data except July 1964. 1 ♀, Devil's River, *Val Verde Co.,* TEXAS, May 6, 1907, Bishopp and Pratt, at light (misidentified as *S. notatum* Adams by Malloch (1914). 2 ♀♀, Las Cruces, *Doña Ana Co.,* NEW MEXICO, June 25, 1895, Cockerell (originally identified by Cockerell as *S. ochraceum* Walker, and later as *S. notatum* by Malloch). Holotype and paratypes deposited in the U.S. National Museum of Natural History, Washington, D.C.

DEDICATION. This small, colorful species is named in honor of my youngest daughter Robyn who is colorful in her own right and who has brought much joy, enthusiasm, and uncommonly good sense into our home.

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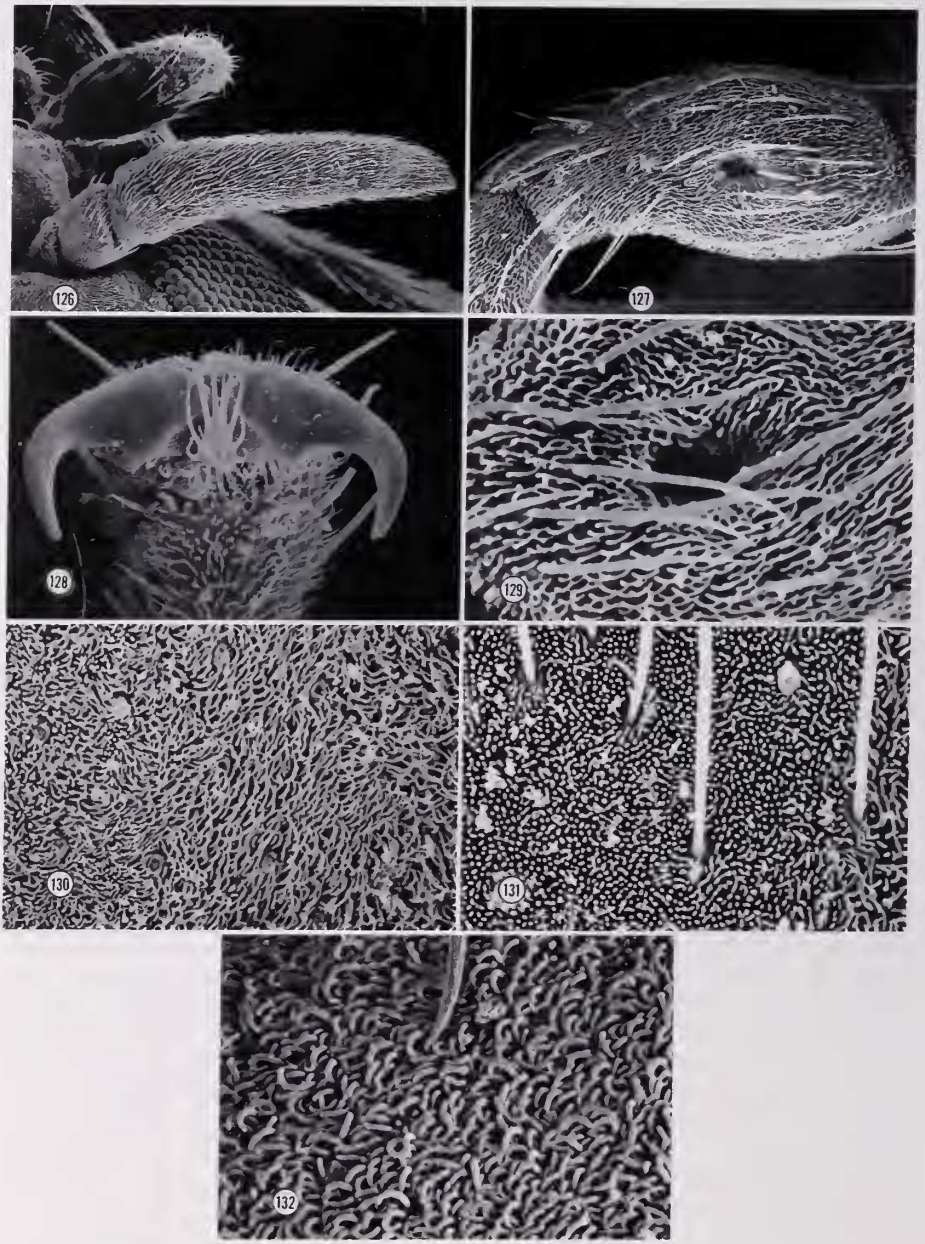
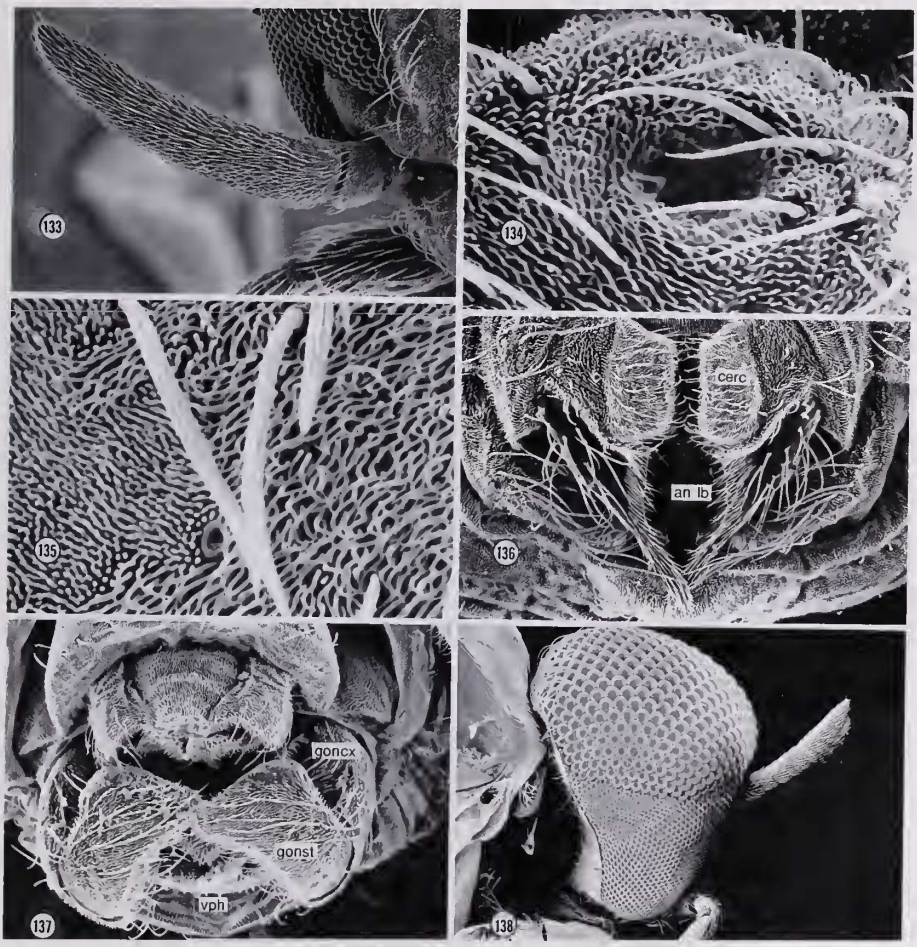
Figs. 118–121. *Simulium labellei.* 118. Male terminalia. *Simulium robynae.* 119. Male terminalia. *Simulium labellei.* 120. Female terminalia. *Simulium robynae.* 121. Female terminalia.

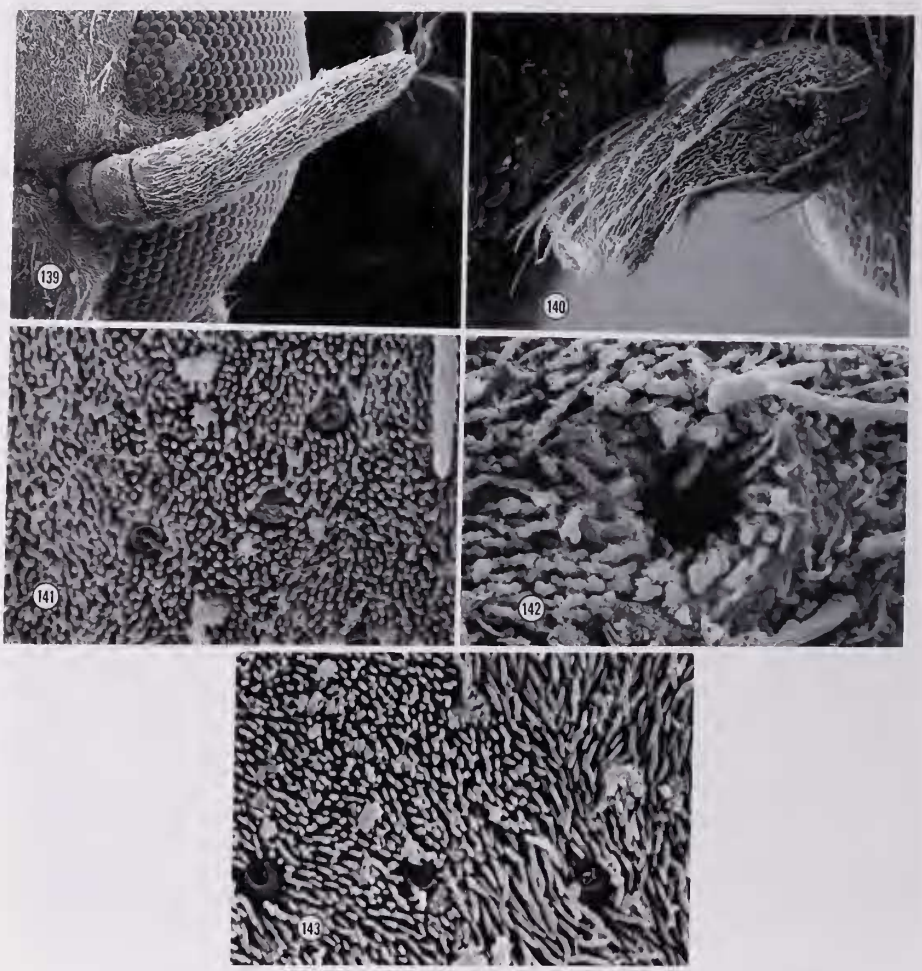


Figs. 126–132. SEM Micrographs. *Simulium mediovittatum,* female. 126. Portion of head showing antenna, and portion of third palpomere and eye. 127. Third palpomere showing mouth of sensory organ. 128. Claws and empodium. 129. Enlargement of mouth of sensory organ. 130. Portion of thorax showing variation in patterns of microtomentum. 131. More enlarged view of microtomentum. 132. More enlarged view of longer microtomentum.



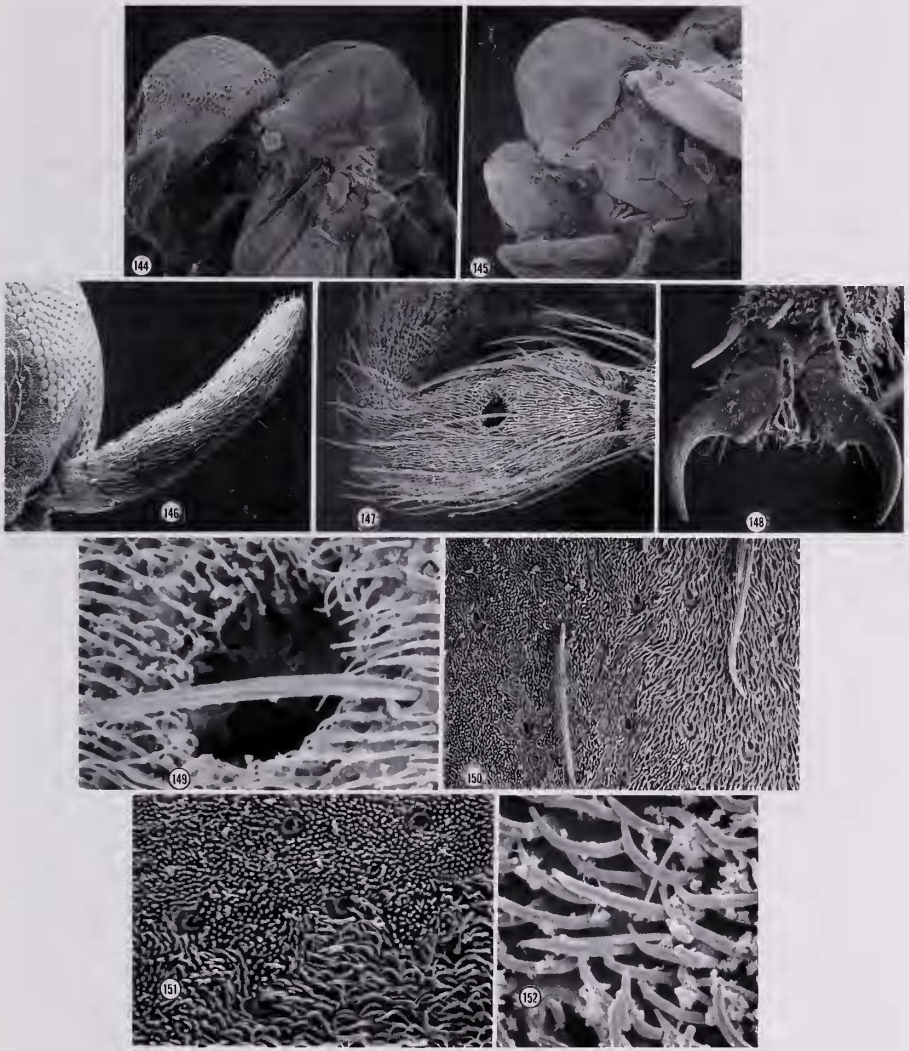
Figs. 133–138. SEM Micrographs. *Simulium trivittatum.* 133. Portion of female head showing antenna, third palpomere, frons, fronto-ocular triangle, and eye. 134. Enlarged view of mouth of sensory organ of female third palpomere. 135. Enlarged view of portion of thorax showing variation in microtomentum. 136. Female terminalia, posterior view. 137. Male terminalia, posterodorsal view. 138. Lateral view of male head.

REMARKS. *Simulium robynae* is variable in color but the orange form seems far more common than the darker form. Even so, the dark form usually has conspicuous amounts of orange color dorsally along the edges of the postpronotum, scutum and notopleuron. A number of the available specimens are dried and shriveled or are greased, and this may account for at least some of the darkening of the specimens. This species is similar to *labellei* especially in the shape of the scutum and terminalia of both sexes, and in the immature stages. These two species can be separated by the characters given in the keys. *Simulium robynae* seems to be a smaller, paler



Figs. 139–143. SEM Micrographs. *Simulium venator,* female. 139. Portion of head showing antenna, and parts of frons, fronto-ocular triangle, and eye. 140. Third palpomere showing mouth of sensory organ. 141. Enlarged view of portion of thorax showing mirotomentum. 142. Enlarged view of mouth of sensory organ. 143. View of portion of thorax showing patterns of microtomentum.

version of *labellei* and the two species are obviously more closely related to each other than to the other species treated here, and may merit their own subgeneric placement. This species has been misidentified as *notatum,* but the two species are clearly distinct and are distinguished by the shape of the scutum, that of *notatum* being much more flattened than the conspicuously arched scutum of *robynae.* Other differences are found in the form of the female terminalia, and the darker legs in the female of *robynae.* Also, refer to the discussion under *labellei.*



Figs. 144–152. SEM Micrographs of *Simulium labellei*. 144. Lateral view of male head and thorax. 145. Lateral view of female head and thorax. 146. Portion of female head showing antenna, and parts of frons, fronto-ocular triangle, and eye. 147. Third palpomere of female showing mouth of sensory organ. 148. Female claws and empodium. 149. Enlarged view of mouth of sensory organ. 150. View of portion of thorax showing patterns of microtomentum. 151. More enlarged view of microtomentum of thorax. 152. More enlarged view of longer microtomentum of thorax.

Other workers thought that this species was *notatum*. According to Cockerell (1897), he was called on June 25, 1895, by Prof. A. Goss to see enormous numbers of specimens of this species on his horse, which was on the campus of the New Mexico Agricultural College, Mesilla Valley, New Mexico. According to Cockerell, Mr. D. W. Coquillett later identified this material as *Simulium ochraceum*, and suggested that since this species had never before, or since, been seen in the Mesilla Valley, that it must have arrived from some distance away. Although Coquillett apparently identified this material as *ochraceum*, he never mentioned its presence in New Mexico in his paper of 1898. However, he did mention *ochraceum* from Colorado and Montana but the specimens on which this identification was based were really *Prosimulium fulvum*, a species he named in 1902 (Malloch, 1914; Peterson, 1970). Malloch (1914) subsequently misidentified these three specimens as *notatum*, and Dyar and Shannon (1927) accepted this identification.

BIOLOGICAL NOTES. Practically nothing is known about the biology of this tiny species. Cockerell (1897) mentioned that it was taken from horses, and there are alcohol preserved specimens, with blood in their abdomens, labeled as from horses and a jackrabbit. Most of the material in the USNM was taken in light traps. Several pupae, two mature and several immature larvae were collected by the author from trailing vegetation along the margins of the Rio Grande, near Big Bend National Park, Texas, in the shallowest parts of the river. Both the pupae and larvae are pale yellowish in color and were difficult to see in the turbid waters of the river.

ACKNOWLEDGMENTS

I am grateful to P. (Nit) Malikul, laboratory technician, Systematic Entomology Laboratory, for her help in various ways, especially for taking and mounting most of the SEM micrographs. I am also grateful to Susann Braden, USNM, for her painstaking efforts in taking several of the very high magnification SEM micrographs. Most of the illustrations were commissioned under the initiative of Alan Stone, formerly of the Entomology Research Division, ARS, USDA, and were prepared by various artists with the former 406th Medical General Laboratory, U.S. Army, Japan. I am most grateful to Alan Stone for making these illustrations available for this paper. Some of the line illustrations were prepared by Linda H. Lawrence, staff illustrator, Systematic Entomology Laboratory (Figs. 51, 93, 110–121), and Elizabeth Lockett, contract illustrator, Baltimore, MD (Figs. 78–80, 90–92). I thank P. H. Adler, Department of Entomology, Clemson University, Clemson; K. P. Pruess, Department of Entomology, University of Nebraska, Lincoln; M. E. Craig, Department of Entomology, New Mexico State University, Las Cruces; R. E. White, A. L. Norrbom, M. E. Schauff, and D. R. Miller, Systematic Entomology Laboratory, who kindly read the manuscript and made helpful suggestions.

I am grateful to the following persons and institutions who loaned or contributed material for use in this study: P. H. Arnaud, Jr., California Academy of Sciences; R. C. Bechtel, Nevada State Department of Agriculture; G. W. Byers, and J. Gelhaus, University of Kansas (UKaL); M. E. Craig, New Mexico State University; J. M. Cumming, Agriculture Canada (CNC); W. J. Hanson, Utah State University; R. O. Hayes, Public Health Entomology, Consultation, Planning, Assessment, Domestic and Foreign, Fort Collins, Colorado; R. H. Jones, formerly Arthropod-borne Animal Diseases Research, ARS, USDA, Denver, Colorado; B. C. Kondratieff and M. Harris, Colorado State University; W. L. Kramer, Division of Environmental Health and Housing Surveillance, Nebraska Department of Health, Lincoln; K. P. Pruess, University of Nebraska.

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* Also spelled: Rubtzov, Rubzov, Rubsov, Rubcov, plus several other versions. Rubtsov is adopted here to maintain consistency with recent common usage by English speaking black fly workers.

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Received 17 April 1992; accepted 6 August 1992.